DEPARTMENT OF THE ARMY
FORT DETRICK
FREDERICK, MARYLAND 21701

IN REPLY REFER TO:

SMUFD-AE-T

30 August 1968

SUBJECT: Revisions to Fort Detrick Design Criteria Manual

TO: All Recipients of the Manual

The document [illegible] 1 page B

~~In 1966, Fort Detrick issued the following publication:~~ Technical Engineering Division and Industrial Health & Safety Division. 1 March 1966. Design criteria for microbiological facilities at Fort Detrick, (In 2 volumes: Volume I, Introduction; Volume II, Design Criteria). Fort Detrick, Frederick, Maryland, 21701.

Our records indicate that your office received one or more copies of this publication. Accordingly, we are forwarding herewith the appropriate number of copies of current revisions to Volume II. Each set consists of revised pages and a covering Check List indicating how the revisions should be inserted in Volume II. AD 480716

Should any of your sets of revisions be incomplete, or if you received an insufficient number of sets, write to the following address:

Commanding Officer
Fort Detrick
ATTN: Technical Releases & Editorial Branch
Technical Information Division
Frederick, Maryland 21701

If you receive more sets than you need, we also would appreciate return of any extras to the same address.

Inquiries concerning the content of the revisions should be addressed similarly, except change the attention line to ATTN: Chief, Technical Engineering Division.

Gerald W. Beveridge

1 Incl
As stated

GERALD W. BEVERIDGE
Chief, Technical Information Division

CHECK LIST FOR REVISIONS TO FORT DETRICK DESIGN CRITERIA MANUAL

All of the attached revised pages are for Volume II of the manual, and they have been assembled in order, starting at the front and working through the back of the volume. The pages in the original edition of the manual are dated 2/66 just outside the border in the lower left corner; the revised pages are dated 3/68 in the same location. Remove pages dated 2/66 and replace with pages dated 3/68 as follows:

Section of Manual	Pages to be Replaced	Plates to be Replaced
Table of Contents, List of Plates	viii	None
Subject Index	I.1 through I.10 (entire section)	None
1. Architectural and Structural	1.12, 1.24, 1.25, 1.26, 1.35	1.15, 1.16
2. Heating, Ventilation and Air Conditioning	2.2, 2.4, 2.14, 2.15, 2.16, 2.19, 2.21, 2.22, 2.23, 2.24	? 1
3. Piping	NOTE: This entire section has been revised; change as follows: (i) remove original text pages 3.1 through 3.36 and replace with new pages 3.1 through 3.39, and (ii) remove original plates 3.1 through 3.8 and replace with new plates 3.1 through 3.11.	
4. Equipment and Accessories	4.7, 4.8, 4.15, 4.18, 4.20, 4.21	4.8, 4.9
5. Electrical	5.6, 5.8, 5.12, 5.16, 5.18	5.1
6. Instrumentation and Controls	6.5, 6.6, 6.7	6.1
Glossary	G.1, G.2, G.4, G.5, G.7, G.8	None

SUBJECT INDEX

* Underlining indicates principle reference.

sub-section 5-03, ELECTRICAL. The U.V. door barrier may be omitted for air locks serving rooms (other than pilot plant units) in which all the equipment is housed in gastight cabinets.

5. Floor Drainage: Air lock floors shall slope toward the more contaminated rooms or corridor for drainage purposes.

1-02 NON-CONTAMINATED ROOMS

A. List of Rooms

1. The main non-contaminated area will include some or all of the following rooms:

Entrance corridor
Reception area
Change room(s)
Main office
Laboratory Director's office
Other offices
Conference rooms and vaults
Lunch room
Receiving and storage
Cage washing
Animal holding
Glassware washing
Laboratories
Janitor closets
Connecting corridors
Lavatory

2. Other non-contaminated areas, which in general will be separate from the main area, include the following:

Attic (for HV&AC and other equipment)
Utility equipment room(s)

B. Requirements

1. Main Office: The main office has provision for storage of records, files, and photographs, and controls for the building's communications.

2. Office Space: The amount of space for non-contaminated offices and laboratories may be varied according to need.

3. Viewing Panels and Speaking Diaphragms

a. Except for a sealed crash door, no communicating door is permitted directly from the non-contaminated to the contaminated areas. Instead, a viewing panel and a speaking diaphragm shall be provided in the corridor partition separating these areas (see 1-05 F and Plate No. 1.1).

a. Epoxy-aggregate topping shall have a minimum thickness of 1/8" (3/32" to 5/32"). Greater thickness (3/16" to 1/4") shall be specified in locations of unusual wear.

b. Epoxy topping shall be furnished, installed, and guaranteed by one and the same flooring contractor, experienced in this type of flooring.

c. Epoxy topping shall be installed in such a manner as to provide a continuous waterproof barrier, including seals, around penetrations and drains, carrying the topping up the sides of curbs, and with the avoidance of feather-edging.

d. The required floor pitch shall be provided in the pouring of the original structural slab.

e. Epoxy-aggregate topping shall be used for re-surfacing of damaged or deteriorated floors in areas specified in 1-05 C.5. Where the old concrete is in particularly bad condition, the use of epoxy-aggregate reinforced with glass cloth should be considered.

6. Heavy Duty Cement Finish Floor: Alternate finish floors for contaminated areas, for floors on grade which are sealed with membrane (see 1-04 J), may be Kalman "absorption process" heavy duty cement finish floor.

7. Conductive-type Floors: Conductive-type floors conforming to the requirements of Ordnance Safety Manual ORD M 7-224 shall be used in spaces where risk of explosion may exist (see also 5-06, ELECTRICAL).

8. Vinyl Tile: Vinyl tile floor covering over applied cement finish shall be installed in non-contaminated offices and conference rooms and non-contaminated corridors. Inlaid vinyl sheet floor covering with a minimum of seams shall be installed in radiological laboratories.

9. Protective Coatings: See 1-06 C.3 for protective coatings on floors.

D. Ceilings

1. Smooth Finish Concrete: Unless otherwise specified, smooth finish concrete ceilings shall be used in all contaminated areas.

2. Suspended Ceilings: See 1-04 G.

3. Seals Around Penetrations: See 1-05 E.

4. Lighting Fixtures: Lighting fixtures shall not be recessed in the ceiling (see 5-02 D.2, ELECTRICAL).

E. Seals Around Penetrations

1. Floors: Seal shall be provided around all pipes, conduits,

instrument tubing and ducts at each floor level including attic floor through which they pass. See Plates No. 1.15, 1.16, 1.17, and 1.18 for methods of sealing around pipes, conduits, instrument tubing and ducts at floors.

2. Walls: Seal shall be provided around all pipes, conduits, instrument tubing and ducts passing through walls separating non-contaminated and contaminated areas or separating two areas of different levels of contamination. A continuous demarcation line shall be indicated on the floor plan along such walls to distinguish them from other walls. See Plates No. 1.17, 1.18, 1.19, and 1.20 for methods of sealing around pipes, conduits, instrument tubing and ducts at walls.

3. Anchoring: Pipes shall not be anchored in walls or floors unless a thorough stress analysis has been made that indicates it can be done safely. Conduit may be anchored in floors and interior walls.

4. Internal Conduit Seal: See 5-02 B.3, ELECTRICAL.

F. Windows

1. Exterior Walls: Glass block masonry openings, with a small double-pane insulating window unit for view panel, are used in exterior walls of all contaminated areas instead of other type windows. Interior face of glass block shall be smooth. Exterior shall be flush with wall to avoid recesses that attract pigeons. All mortar used in glass block masonry construction, including the joints between glass blocks and metal surfaces, shall be of a type to provide tight, non-shrinking, waterproof, corrosive-resistant joints.

2. Viewing Panels: Clear wire glass viewing panels or windows shall be set in two component sealing compound (see 1-06 A) in pressed steel frames, with lower edge 58 inches above floor. Minimum size shall be 24 by 36 inches in walls; for doors see Plate No. 1.14.

a. For required use in walls, see 1-01 C.2f, 1-02 B.3, 1-02 B.9, and 1-03 C.6.

b. For required use in doors, see 1-05 A.3 and Plate No. 1.14.

3. Speaking Diaphragms: Clear plastic speaking diaphragms, similar to those shown in Plate No. 1.21, shall be installed alongside or in viewing panels in wall, and with lower edge 58 inches above floor in doors. Speaking diaphragms may also be installed in glazed doors. An example is shown on Plate No. 1.22.

a. For required use in walls, see 1-01 C.2f, 1-02 B.3, 1-02 B.9.

b. For required use in doors, see 1-05 A.2.

G. Elevators and Dumbwaiters

1. Elevator Size, Capacity, and Speed: The minimum elevator platform size shall be 5 x 7 feet; capacity 3500 pounds; speed, 150 feet travel per minute.

2. Doors: To minimize drafts between floors, elevator and dumbwaiter shafts shall have a door at each floor. Elevator doors are covered in 1-05 A.11.

3. U.V. Barriers: For U.V. barriers at elevator and dumbwaiter door openings see 5-03 B, ELECTRICAL.

H. Stairways: See 1-01 C.5 and 1-01 C.7.

I. Builders' Hardware

1. General: There are relatively few special criteria for hardware related to safety considerations, and these are listed below. More extensive information based on conventional requirements will be found in 1-08 D, Fort Detrick Design Practices.

2. Selection of Hardware Sets: Door hardware will be selected by the Government, from the sets listed in 1-08 D.7. Marked floor plans indicating the desired set for each door will be furnished to the architect-engineer.

3. Hospital Pull Arms: Hospital pull arms are used on doors located in contaminated areas with push plates on opposite side.

4. Armor Plates: See 1-05 A.6.

5. Emergency Exit (Crash) Doors: See 1-05 A.12 and 1-08 D.7.

6. Doors to Disinfectant Showers: See 1-05 A.8 and 1-08 D.7.

7. Locks and Latches

a. Unless otherwise specified, locks for all exterior doors and locks on interior doors at either end of air locks shall be type 86A-4 (Fed. Spec FF-H-106a) with Best Universal cylinder #1E64 less core.

b. Unless otherwise specified, locks for interior doors shall be type 85-D-4 (Fed. Spec FF-H-106a) and shall be mastered to Sargent LH 44700 x M.

c. Locks will be provided on interior doors only when specifically designated.

whether the outside handle is padlocked or free.

g. Emergency Exit (Crash) Doors:

H20
Butts
Panic Bolt 821

h. All Exterior Doors (unless otherwise specified):

H21
Butts
Cylinder Mortise Lock, Best Universal #2600-MO6E02 with cylinder 1E64 less core.
Door Closer

H22
Butts
Cylinder Mortise Lock, Best Universal #2600-MO6E02 with cylinder 1E64 less core (on active leaf)
Door Closer (on active leaf)
Lever Extension Flush Bolts 1045 and 1048 (on active leaf)

H23
Butts
Cylinder Mortise Lock, Best Universal #2600-MO6E02 with cylinder 1E64 less core (on active leaf)
Lever Extension Flush Bolts 1045 and 1048 (on inactive leaf)

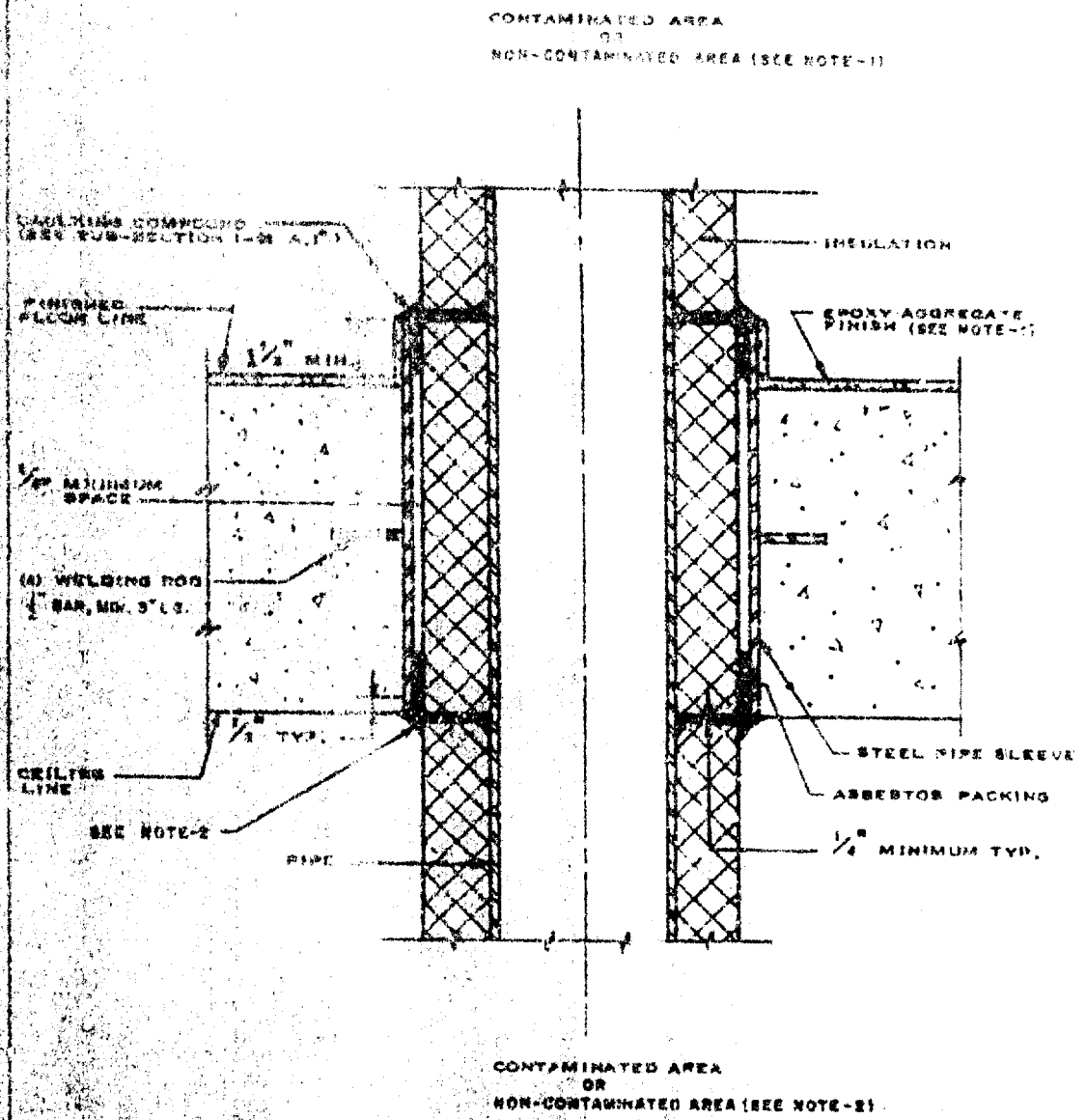
i. Doors to Disinfectant Showers:

H24
Butts, Refrigerator Door Type Hinge, corrosion-resistant steel.
Fastener, 3 point interconnected Smokehouse type "Jamison" or equal with inside operating lever and "O" ring seal on fastener thru-rod, corrosion-resistant steel and US26 finish. All hardware shall be factory applied.

E. Protective Coatings

1. Contaminated Areas: See 1-06 C.

2. Non-Contaminated Areas: Non-contaminated areas shall be painted with semi-gloss enamel paint conforming to Federal Specifications TT-E-508, except that:



* FOR SURFACE TEMPERATURES ABOVE 250° F USE SILICONE-TYPE SEALANT, SEE I 06 A.3

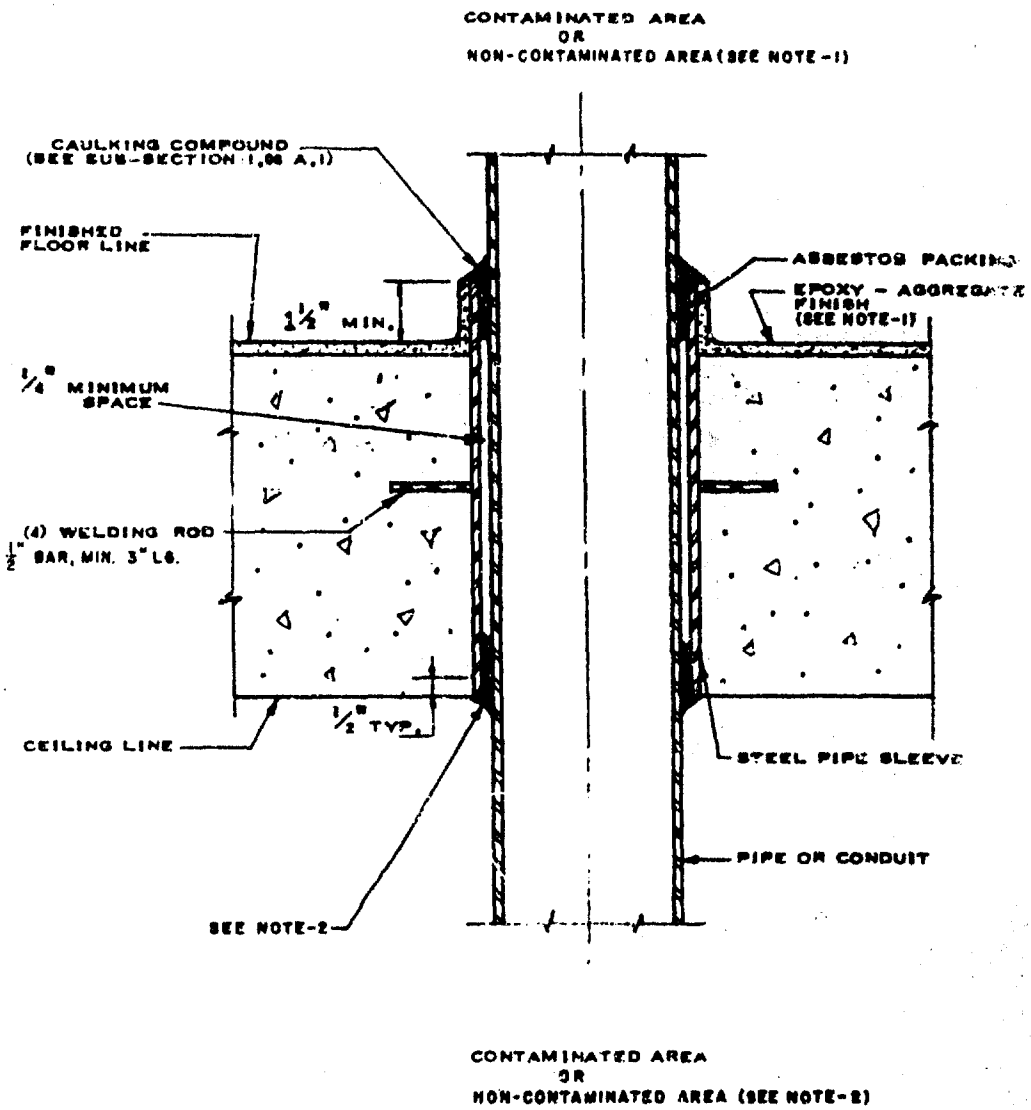
NOTE-1, NON-CONTAMINATED AREA FLOOR FINISH (PER SUB-SECTION I-04 A.2C)

NOTE-2, NON-CONTAMINATED AREA, PACKING AND CAULKING OPTIONAL

NOTE-3, NON-CONTAMINATED AREA BOTH SIDES, PIPE SLEEVE OPTIONAL

TYPICAL METHOD OF SEALING AROUND INSULATED LINES EXTENDING THROUGH FLOORS	1	29 AUG 67	ADDED NOTES 1, 2, & 3
	REV.	DATE	DESCRIPTION
	DATE - 1 FEB. 65		PLATE NO. 1.15

3/85



NOTE-1 NON-CONTAMINATED AREA FLOOR FINISH (PER SUB-SECTION 1-04 J,2C)

NOTE-2 NON-CONTAMINATED AREA, PACKING AND CAULKING OPTIONAL

NOTE-3 NON-CONTAMINATED AREA BOTH SIDES, PIPE SLEEVE OPTIONAL

TYPICAL METHOD OF SEALING AROUND NON-INSULATED LINES EXTENDING THROUGH FLOORS	⚠1 23AUG 67	ADDED NOTES 1,2,&3
	REV. DATE	DESCRIPTION
	DATE 1 FEB. 66	PLATE NO. 1.16

3/68

2-04 SUPPLY AND EXHAUST SYSTEMS, GENERAL

A. Typical Systems: See Plate No. 2.1 for diagram of typical supply and exhaust systems.

B. Location: The central supply and exhaust systems shall be located in a non-contaminated attic area.

C. Central Supply System

1. Prefilter: Prefilters shall be of the automatic renewable-media ("roll-up") type. They shall be controlled by automatic timers since pressure controllers have been found not sensitive enough for this application.

2. Preheat Coils: Preheat coils are a common source of trouble caused by corrosion or freezing, and this has been aggravated at Fort Detrick by the requirement for 100% outdoor air, and the frequency with which normal winter temperatures range up and down through the freezing point. For these reasons it is important to design and install the intake air and heating coil installation with great care to prevent freeze-up.

3. Cooling Coils: All chilled water air cooling coils shall be the completely drainable type. Coils shall have removable cast iron headers on at least one end, arranged so that each tube is individually drainable. A threaded plug shall be provided in the headers opposite each tube to facilitate cleaning. Each header shall be provided with a vent and drain plug. Tube interiors shall be prime surface with no interior fins or devices to increase water velocity.

4. Humidifier: Consideration shall be given, if requested by the Government, for provision of a humidifier in the central supply system. This would be designed to raise the humidity to a high level in a short time, for use in building decontamination with chemicals.

5. Bacterial Filters: Space for future installation of bacterial filters shall be provided because of the possible need for a germ-free environment in future work.

6. Alternate Systems: The supply system shown in Plate No. 2.1 employs reheat coils in supply ducts to individual rooms. This type of system has been generally used at Fort Detrick. Alternate systems, such as multizone systems with "blow-through" fan and coil equipment or double duct systems with constant volume mixing boxes, may be considered for specific installations. However, no design work shall be done on such alternate systems unless specific approval has been requested and received from the Government.

7. Separation of Supply and Exhaust: The building ventilation outside air inlets shall be separated as far as practicable from the points of exhaust. In selecting locations consideration shall be given to prevailing wind patterns of the geographical area. (At Fort Detrick it is preferable to locate exhaust discharges generally east of the air inlets; see 2-13 B).

8. Outside Air Intake: In the design of outside air intakes, consideration must be given to their continuous operation in adverse weather. Rain and snow must be baffled out of the air stream so it will not wet or clog the filter. Plenum floors must be water-tight and provide for drainage. Preheat coils and their associated controls and piping shall be designed and arranged to prevent them from freezing. Uniform air velocities across the face of louvers, filters and coils are essential. Baffle shall be installed to minimize effect of wind on air supply.

D. Central Exhaust System

1. Exhaust Fan: The main exhaust fan shall be equipped with variable inlet vanes, which shall be regulated by a static pressure controller to insure a reasonably constant negative pressure in all exhaust ducts as filter resistance changes.

2. Exhaust Stack

a. Velocity: The exhaust stack shall extend at least 5 feet higher than the highest point of the roof and shall provide a vertical uncovered discharge at a minimum velocity of 2,500 fpm.

b. Location: The exhaust shall be downwind (east) of the air inlets (see 2-04 C.6 above).

E. Room Ventilation

1. Individual Rooms: See Table 2.1.

2. Special Rooms: See 2-05 below.

3. Constant Air Flow: In order to insure a reasonably constant air flow rate to each room at all times (see 2-02 B.4), the following measures are taken.

a. Room Exhaust Pressure: A static pressure regulator in the main contaminated exhaust duct (see Plate No. 2.1) controls the exhaust fan inlet vanes to maintain constant exhaust pressure.

b. Operational Controls: Manual valve adjustments and automatic dampers are used to compensate for buildup of filter resistanc. in individual exhaust systems (fume hoods, safety cabinets, animal room exhaust, etc.).

c. Equipment Exhausts: The individual exhaust systems for all types of equipment are operated continuously (fume hoods, safety cabinets, etc.). Equipment exhausts shall be included in determining the minimum number of air changes per hour (see 2-01 E).

d. Fume Hoods: Fume hoods are equipped with automatic compensating devices to maintain constant exhaust flow from the room as hood opening is varied.

2-05 SPECIAL ROOMS

A. General: This sub-section supplements Table 2.1, in which individual ventilation requirements for various types of rooms are listed in the column headed "Remarks".

B. Animal Rooms

1. Reference: See Table 2.1, Item 6.

2. Types of Room: See 1-03 C, ARCHITECTURAL.

3. Animal Cages and Cage Racks: For definitions and descriptions see 4-02, EQUIPMENT.

4. Ventilated Cage Racks: For the ventilation requirements of closed ventilated cages on racks see 2-07 B. and Plate No. 2.2.

5. Humidifier: The individual humidifier required for room humidity control may be located in the room or the attic, depending on the circumstances.

6. Constant Air Flow: To avoid variation in the room air flow when a cage rack is removed from the cage exhaust manifold, a fixed orifice is inserted in its place, as indicated on Plate No. 2.2. When only non-ventilated cages are used in the room, orifices are used in all manifold connections.

7. Air Motion: Air velocity shall not exceed 40 fpm in vicinity of open cages, to avoid drafts. Diffusers are not desirable. Exhaust should be located so that air in contact with animals will not be circulated past other animals.

8. Dust and Dirt: The air supply and distribution systems shall be designed to minimize the pickup and redistribution of animal hair, dust, and dirt. Filters that are easily serviced from the room shall be installed over the room exhaust openings. A roughing filter shall be provided in the cage rack exhaust manifold (see Plate No. 2.2).

9. Insulation and Vapor-Barriers: See 1-05 B.1, ARCHITECTURAL.

10. Emergency Ventilation System: If the animal rooms are equipped with an emergency power system and fan, exhaust should be through a separate roughing filter, HEPA filter, and then through the fan directly to the outside of the building (see plate No. 2.1).

C. Glassware and Cage Washing Rooms

1. Reference: See Table 2.1, Item 7.

2. General: Since the equipment used is a source of high heat and humidity, air conditioning to maintain comfort conditions is not economical or feasible. The present approach is to hood the equipment to remove as much heat and humidity as possible at the source, and to ventilate with a limited amount of conditioned air.

exhaust connections shall be located directly above or as close as practical to sources of heat, such as sterilizers, or to sources of high contamination.

b. Each air inlet and exhaust outlet in the cabinets shall be equipped with a diaphragm valve located at the ventilation connection on top of the cabinet to allow halogen leak-testing of the cabinets (see 4-18, EQUIPMENT).

c. When more than six (6) cabinet units are connected together in one cabinet system, two or more sources of supply and exhaust will be used.

4. Flow Rate

a. The minimum ventilation rate shall be 10 air changes per hour (4 cfm per standard 30" x 40" x 34" cabinet unit), or sufficient to limit to 10°F the temperature rise due to internal heat load, whichever is greater.

b. The cabinet exhaust system shall be designed to maintain a minimum velocity of 50 fpm through a single open glove port. (In general, this requirement is met by the above-specified flow rate).

5. Inlet Filter

a. The source of air for cabinet ventilation is the laboratory room air. It shall enter the cabinet through a single high-efficiency particulate air filter attached to the flanged opening provided on top of the cabinet. For details of the Standard Biological Safety Cabinet Inlet Filters see 2-09 D.1. The filter should be installed between the diaphragm valve and the cabinet.

b. For special applications Class III cabinets may be provided with a special atmosphere (inert gas, low humidity, etc.). In such cases the required flow rate may be less than 10 changes per hour; however, the inlet filter size shall be based on 10 changes per hour minimum.

c. Provision shall be made for sterilizing the inlet filter.

6. Exhaust Filter: All air exhausted from Class III Cabinet Systems shall pass through a high-efficiency particulate filter (see 2-09 D.2); provision shall be made for sterilizing the filter. The filter should be installed between the diaphragm valve and the cabinet.

7. Air Incinerator: The cabinet exhaust air shall pass from the exhaust filter to an incinerator. See 4-04 A and B, EQUIPMENT.

8. Exhaust Pipe Lines

a. The exhaust air from Class III cabinets is carried in pipe with gastight welded joints, conforming with the requirements listed in sub-section 2-08, Contaminated Vent System to Incinerator (CVI).

5. Pitch: Exhaust manifold shall pitch ¼-inch per ten feet toward the cage racks.

6. Exhaust Filter: Exhaust air shall pass through a high-efficiency filter (see 2-09 C) and fan located in attic. Fan shall discharge into central exhaust system upstream from the central exhaust bacterial filter.

C. Chemical Fume Hoods and Radiological Hoods

1. General: Exhaust system equipment for chemical fume hoods and radiological hoods shall be vertical, floor mounted type consisting of a welded black iron casing painted on the inside with corrosion-resistant paint, high-efficiency particulate filter (see 2-09), and centrifugal exhaust fan (see Plate No. 2.1).

2. Ducts: Ducts shall be chemical and corrosion resistant and sealed pressure tight. Ducts shall be arranged to avoid condensation or traps.

3. Exhaust Fans: Exhaust fans shall be centrifugal, with cast iron housing and non-sparking wheel. A 3/4" trapped drain to a CCD line shall be installed in bottom of the scroll. Fans shall be provided with vibration-isolation bases. No litharge-glycerine cement shall be used on the exhaust fan housing or any other parts of the exhaust system.

4. Flow Rate: The exhaust system shall be designed to produce a linear flow of 50 fpm across the front of hood with sash raised.

5. Constant Air Flow: See 2-04 E.3.

6. Exhaust Line: Exhaust line shall go directly from fan located in attic to outside through roof.

D. Refuse Incinerator: See 4-04 C, EQUIPMENT.

2-08 CONTAMINATED VENT SYSTEM TO INCINERATOR

A. Application: In general air from exposure chambers and process equipment in which aerosols of infectious or toxic substances are formed or are likely to occur will be exhausted through the CVI (contaminated vent incinerator) system. Also, any item of equipment having waste connections to a liquid waste collection treatment unit will be vented to the CVI system. The following list, not necessarily all inclusive, includes equipment from which air is exhausted or vented to the CVI system.

1. Waste collection treatment units.

2. Class III biological safety cabinets.

3. Plumbing vents on equipment connected to Class III biological safety cabinets.

4. Air wash unit on sterilizers connected to Class III biological safety cabinets.

5. Vacuum discharges from equipment connected to Class III biological safety cabinets.

6. Discharge from safety valves on sterilizers that are attached to Class III biological safety cabinets.

7. Discharge air from process equipment.

8. Aerosol chambers.

B. Steam-Out Connections: Provide block valves and steam connections in CVI lines before leaving the building to permit steaming out the CVI system. Facilities and connections for halogen leak testing should also be provided.

C. Materials and Accessories: See 3-04 F.4, PIPING.

2-09 BACTERIAL FILTERS

A. General: Bacterial filters are used primarily on exhaust lines carrying contaminated air (or other gases). They are also used in some cases on air or gas inlets to provide a dust-free or germ-free atmosphere, or to protect the inlet line against possible contamination in case of accidental reversal of flow. In cases where moisture and condensation can be present, a suitably resistant filter should be used.

B. Filter Efficiency: The efficiency of bacterial filters should be evaluated by tests on the removal of nebulized, or naturally occurring, microorganisms from air. Two classes of bacterial filter (in addition to roughing or pre-filters) are used at Fort Detrick:

1. High-Efficiency Particulate Filters (HEPA): HEPA filters will remove a minimum of 99.97% of biological particles, 0.3 micron or larger from air.

2. High-Efficiency-Filters: High-efficiency filters have a nominal efficiency of 95% for removal of 0.3 micron or larger biological particles from air.

3. Seals: For filters of such high efficiency it is particularly important, both in tests and in actual service, to insure against leaks through the seal around the filter frame.

4. Filter Efficiency: Filter efficiency will be determined by the standard DOP method.

C. Filter Media

1. Non-Combustible: Media for bacterial filters shall be non-combustible and suitable for service at temperatures up to 600°F.

2. Humidity: High-efficiency particulate filters shall be suitable for service with air at 100% relative humidity at room temperature.

3. Media Types: Media to be used in bacterial filters are not restricted except by performance requirements. However, a brief description follows of types that have given satisfactory performance in past and current use.

a. Media for High-Efficiency Filters: For so-called deep bed and other high-efficiency filters, the most commonly used media have been mats of glass fibers lightly bonded with phenolic resin. Type I media employs superfine fibers (1.28 microns or less in diameter) and has a nominal efficiency of 99%, as defined above. It is often used in series with Type II media, which employs fine fibers (Averaging 2.54 microns in diameter) and has an efficiency of about 60%.

b. Media for High-Efficiency Particulate Filters: The commonly used media for ultra-high-efficiency filters are glass or glass-asbestos paper, using a continuous sheet folded into closely spaced pleats, and integrally sealed into a factory constructed frame.

D. Filters for Class III Safety Cabinets

1. Inlet Filter

a. For required use see 2-06 D.5.

b. Safety cabinet inlet filter employs an ultra-high-efficiency medium (see 2-09 B.1). For details of filter design see Fort Detrick Drawing No. F93-1-6419, Sheet 1 of 2.

2. Exhaust Filter

a. For required use see 2-06 D.6.

b. Safety cabinet exhaust filter employs an ultra-high-efficiency medium (see 2-09 B.1). For details of filter design see Fort Detrick Drawing No. F 93-1-6419, Sheet 2 of 2.

E. Filter Sterilization: Bacterial filter sections installed in plenums or casings shall be equipped with a steam-formaldehyde spray system for sterilization. Steam and formaldehyde shall be supplied at a point as far as possible upstream of the filters through a connection on the casing by means of an ejector system as shown on Plate No. 2.3. Ejectors shall be of the steam-operated type.

2-10 METHODS AND MATERIALS

A. Exhaust Ducts

1. Exhaust ductwork carrying contaminated air through non-contaminated areas shall be made pressure tight (as determined by soap bubble test at +4 inches w.g.), including all joints and seams.

2. Contaminated exhaust ducts that run outside of a building will have soldered or welded joints and will pitch to a contaminated drain.

The exterior of such ducts will be painted with a weather resistant coating.

B. Caulking of Duct Penetrations

1. Ducts passing through floors, or through walls separating areas of different contamination levels, shall be sealed as specified in 1-05 E, ARCHITECTURAL.

2. Where ducts pass through walls or partitions within the same level of contamination or in non-contaminated spaces, special sealing shall not be required, except for grouting and caulking.

C. Caulking of Accessories: Caulking of casing flanges on floors, around duct openings, filter frames and supports, louvers, etc. shall be done with Construction Grade Sealing Compound, as specified in 1-06 A.1, ARCHITECTURAL.

D. Exhaust Plenum: The bacterial filter section in the exhaust system shall be set on a waterproof concrete drain pan having a four-inch high curb around its perimeter (see sub-section 3-04 B. 7b, PIPING). Building exhaust ducts shall not enter through the drain pan. See also 2-13 E.1.

E. Insulation

1. Piping insulation, see 3-06, PIPING.

2. Supply ductwork beginning at the cooling coil shall be insulated in the attic, utility spaces, and other unconditioned spaces.

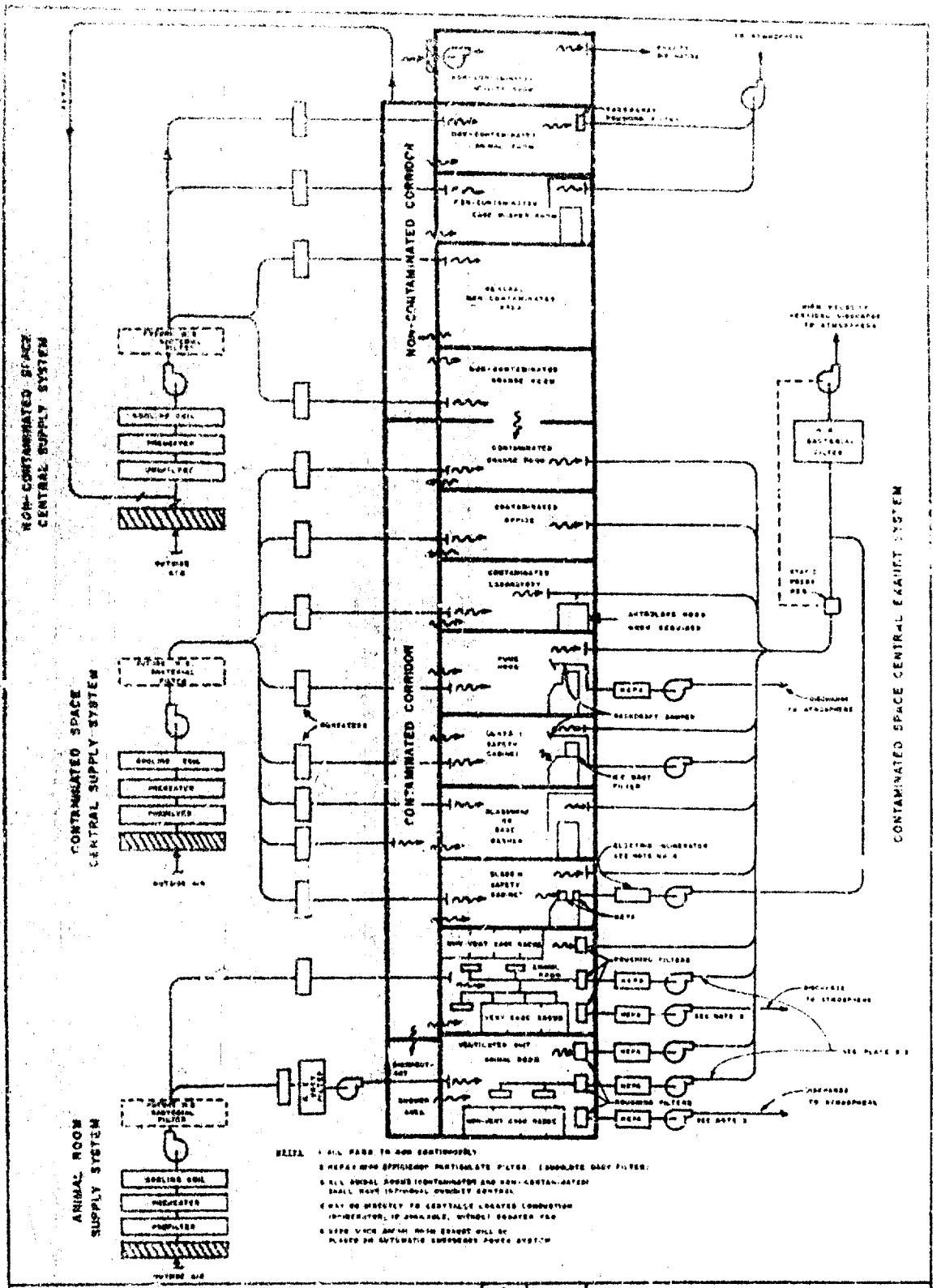
3. All insulation, vapor-barrier, and duct-lining materials shall be noncombustible as defined in section 200 of the National Building Code, shall have a flame-spread rating of not more than 15-20, and a fuel contributed rating of not more than 20-35 and a smoke developed rating of not more than 0, as defined in the Method of Test of Surface Burning Characteristics in the Building Materials List of the National Fire Protection Association.

4. Where insulation ducts are subject to washdown, they shall be covered with a finishing jacket of 8 ounce canvas, cemented in place with lagging cement and covered with two coats of lagging cement. The lagging cement shall be of the polyvinylacetate type. For finish painting see 1-06 C, ARCHITECTURAL.

2-11 CONTROLS

A. Scope: This subsection is limited to special criteria based on biological safety considerations. Additional information will be found in Section 6, INSTRUMENTATION.

B. General: The control system shall be of the electric or pneumatic



TYPICAL AIR FLOW DIAGRAM FOR CONTAMINATE BUILDINGS

REV.	DATE	DESCRIPTION
1	4 AUG 67	GENERAL REVISION

DATE - 1 FEB. 66

PLATE NO. 2.1

SECTION 3 - PIPING

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LIST OF PLATES

SECTION 3

PIPING

3-00 INTRODUCTION

A. Scope

This section is addressed primarily to those architect-engineering personnel concerned specifically with the engineering and design of piping for microbiological facilities at Fort Detrick. It applies to new facilities and to modifications and additions to existing facilities.

B. Organization of Section 3

The remainder of this section is divided into the following main sections:

1. General
2. Service Piping
3. Process Piping
4. Waste Piping
5. Fire Sprinklers
6. Insulation
7. Marking and Color Code

3-01 GENERAL

A. Categories of Piping

1. Service Piping: Service piping includes all contaminated and non-contaminated services.

2. Process Piping: Process piping is used for the transfer of agent material between process systems.

3. Waste Piping: Waste Piping, including drains and vents, is divided into sanitary waste and contaminated waste.

B. List of Piping Services: Table 3.1, sub-section 3-07, lists the names, symbols, and color codes of the various piping services. Color codes not found in this list will be found in ASA, A 13.1.

C. Piping Guide: A guide of material requirements for services, covering piping and tubing, valves, fittings, etc., is given in Appendix C. Recommendations by architect-engineers shall be made when cost, life expectancy, corrosion, or project requirements warrant other materials of construction.

D. Piping Code: General piping shall conform to the National Plumbing Code as detailed in ASA, A 40.8, except as outlined below.

3-02 SERVICE PIPING

A. General

1. Three Categories of Service Piping

a. Contaminated services that serve the contaminated areas of the building. Examples are listed below. It should be noted that the designation "Contaminated Service" does not mean the service itself is biologically contaminated (with the exception of CVA which is potentially contaminated) but only that the service is located in and services a contaminated area.

CCW Contaminated Cold Water Service
CHW Contaminated Hot Water Service
CVA Contaminated Vacuum Service
PRA Process Air (Contaminated)
DPRA Dry Process Air (Contaminated)

b. Non-contaminated services that are the same type of services as the contaminated services, but serve only the non-contaminated areas of the building. Examples are:

NCW Non-Contaminated Cold Water Service
NHW Non-Contaminated Hot Water Service
NVA Non-Contaminated Vacuum Service

c. All remaining services that may serve either the contaminated or non-contaminated areas of the building. Examples are:

CA Compressed Air
DCA Dry Compressed Air
MA Mask Air
IA Instrument Air
PG Propane Gas
100-S 100# Steam
60-S 60# Steam
10-S 10# Steam
DW Drinking Water
DIW Distilled Water
DMW Deionized Water
N Nitrogen
T Decontaminant

2. Valving Requirements

a. Shut-Off Valves: Shut-off valves are required on all branch lines at the headers. Valves are also required on all branch lines entering rooms. All valves must be placed in accessible locations.

b. Diaphragm Valves: Diaphragm type valves are specified for several types of contaminated service (see Appendix C) because of their leak-tight design and suitability for decontamination. Where installation of diaphragm valves is required, they shall be located in a vertical run of the line whenever possible in order to minimize pocketing of the liquid within the valve. When installation is required in a horizontal run of the line, the stem of the valve shall be turned so as to be 15 degrees above the horizontal plane.

c. Foot-Operated Valves: Foot-operated valves are required for all drinking fountains (no hand-operated valves are permitted). On all wash bowls on the contaminated side of the change rooms, foot- or knee-operated hot and cold water valves that are not rodent harborages shall be installed.

d. Elbow-Operated Valves: In at least one (1) sink in each autopsy room, water control shall be by means of elbow-operated valves. These permit turning the faucet t' ... at a constant rate, which cannot be done with a foot pedal.

e. Shower Valves: Change room shower valves shall be of the single unit mixing type, thermostatically controlled. The valves shall be "non-scalding," having pressure equalizing features to allow for sudden pressure fluctuations in the water supply. Strainers shall be installed in the hot and cold water supply lines to the shower valves. No valves shall be installed after the shower control valve.

f. Solenoid Valves: Where pressurized gas systems such as air or nitrogen enter biological safety cabinets or process equipment, they shall be equipped with a solenoid valve controlled by a differential pressure switch on the equipment. The solenoid valves shall be the normally closed type to prevent pressurization in the event of a power failure. Solenoid valves should be preceded by a fine mesh strainer to prevent clogging (see Plate 6.1).

g. Distilled Water Valves: Distilled water outlets shall be equipped with spring-loaded valves.

3. Location of Equipment

a. Unless otherwise specified, the equipment required to provide services for the building, such as compressors, pumps, etc., shall be located in the mechanical equipment room.

4. Services to Special Equipment: The following tabulation lists the piping services normally required for safety cabinets and special equipment. For electrical services see 5-04, ELECTRICAL.

	Hot Water	Cold Water	Propane Gas	Vacuum	Compressed Air	10# Steam	60# Steam	100# Steam
Biological Safety Cabinet, Autopsy	X	X	X	X	X	b		
Biological Safety Cabinet, Class I	X	X	X	X	X	b		
Biological Safety Cabinet, Class III	X	X	a	X	X	b		
Radiological Hood		X	X	X	X			
Chemical Fume Hood		X	X	X	X			
Cage Service Cabinet		X		X	X	b		
Refrigerators (Walk-In)				X	X			
Incubators (Walk-In)				X	X			
Steam-Gas Sterilizer (Combination Steam-Freon ETO Sterilizer)				X			X	
Steam Sterilizer							X	
Sterilizer, Mechanical Air Removal				c				X

NOTES:

a. Should propane gas be required to this equipment (to be specified by the Government), this line must be equipped with a "dead man" type, spring-loaded shut-off valve or an automatic timed (10 minute) type of shut-off valve. Wherever possible, portable canister gas supply, alcohol lamps, or electric heater shall be used in preference to the above.

b. 10# steam shall be provided for carrying out sterilization of cabinets with steam-formaldehyde (see Plate No. 3.1). The steam control valve should be within easy reach.

c. High vacuum must be supplied, either by mechanical or steam jet operation.

5. Miscellaneous

a. Safety Showers: Safety showers shall be equipped with a heavy-duty, quick opening, closing, piston type valve, and shall be installed directly above a floor drain. The safety shower shall be so located and equipped with a chain pull that if a person is temporarily blinded he can feel his way to the safety shower chain. The supply line to the safety shower shall be 1 inch and shall be connected to the non-contaminated water supply system. There shall be no valves installed in the 1-inch line between the quick-opening shower control valve and the main, non-contaminated water supply header. The shower head shall be an 8-inch deluge type with no voids in the flow. It shall be a self-cleaning, non-clogging type that will operate on unfiltered water supplies. The floor under the safety shower shall be painted green. A safety shower shall be installed in each laboratory containing a chemical fume hood or a radiological hood. In addition, one safety shower shall be installed in the contaminated corridor of each building above one of the corridor floor drains and on each floor of the building. A safety shower shall be installed in each dishwashing room in which provision is made for routine use of acid cleaning solution. If a contaminated corridor is separated by an air lock, there shall be a safety shower in each section of the corridor.

b. Hose Bibs: At least one 3/4-inch hose bib shall be provided in each contaminated corridor for washing the area. The hose bib station shall be provided with a hose hook and 50 feet of 5/8-inch I.D. garden type water hose equipped with a pistol grip nozzle. Additional stations shall be installed as required so that all areas can be serviced by 50-foot lengths of hose.

c. Swing Spouts: Swing spouts for water shall be used at all laboratory and glassware washing sinks.

d. Fire Sprinklers: See 3-05.

6. Installation Methods: Service piping shall be installed with sloping lines. The use of check valves should be considered to isolate branch water lines within a large, complex, multiscience laboratory building. To avoid crevices that might permit buildup of contamination, and to promote ease of painting and cleaning, piping should never be mounted in direct contact with a wall. Plate No. 3.2 indicates required spacing between pipe and wall, between adjacent pipes, and method of support, including the use of caulking compound to fill irregularities. Piping shall be supported at least 12 inches below the ceiling for ease of painting and cleaning and to facilitate top connections.

7. Seals Around Penetrations: For details on seals around pipes passing through walls, floors, etc., see 1-05 E, ARCHITECTURAL.

8. Special Requirements: Specific special requirements for the various piping services will be found in the following sub-sections. In general these requirements are for contaminated services. Non-contaminated services, unless otherwise specified, will be in accordance with normal practice.

B. Cold Water, Contaminated Service (CCW)

1. Purpose: Contaminated cold water (CCW) is provided for use in the contaminated areas of the building. For specific purposes CCW may be used in non-contaminated areas.

2. Application: CCW is used in laboratory sinks, glassware washing sinks, building washdown hose bibs, biological safety cabinets, process vessels, and all potentially contaminated areas (except as noted in 3-02 G).

3. Requirements:

a. Source: CCW shall be supplied through a break-tank water system to all pilot plant facilities, process development buildings, and aerobiological facilities. Standard microbiological and virological research laboratories, animal holding facilities, chemistry, biophysics, pathology, and crops research buildings shall be supplied with CCW through an approved type of back-flow preventer valve. At Fort Detrick, there is a primary break-tank system through which all water for the complex of laboratory buildings within the restricted area is supplied. An approved back-flow preventer valve should be of the type that has two (2) spring-loaded vertical check valves and one (1) spring-loaded, diaphragm differential pressure relief valve. A guide to selection of a suitable back-flow preventer valve is one that has been approved by the State of California Health Department (see Plate No. 3.3).

b. Measurement: Any building that is connected to the contaminated sewer shall have a water meter on the main CCW supply header.

C. Hot Water, Contaminated Service (CHW)

1. Purpose: Contaminated hot water (CHW) is provided for use only in the contaminated areas of the building.

2. Application: CHW is used in laboratory sinks, glassware washing sinks, biological safety cabinets, process vessels, and all other potentially contaminated areas (except as noted in 3-02 H).

3. Requirements:

a. Source: CHW shall be supplied to the building by an independent hot water heater supplied by the building CCW system.

D. Vacuum, Contaminated Service (CVA)

1. Purpose: Contaminated vacuum service (CVA) is provided for use only in the contaminated area of the building.

2. Application: Contaminated vacuum outlets are used on all laboratory bench tops and glassware washing rooms. (See 3-02 A.4 for additional locations.)

3. Requirements:

a. Capacity: Requirements at each service outlet shall be 5 cfm at 20 inches of mercury vacuum, unless otherwise specified.

b. Demand Factor: A demand factor of 10% of the total connected load shall be used for design.

c. Source: The vacuum pump for the CVA system shall be located in the utility service area of the building and shall discharge through the contaminated vent to the incinerator system (CVI). If an incinerator vent system is not available, the exhaust shall be discharged to the building air exhaust plenum before the filters. There shall be a pipeline bacterial filter able to operate in a moist atmosphere on the vacuum line immediately before the line enters the surge tank. A water sealed pump shall be used as the vacuum source. The pump shall operate intermittently.

d. Distribution: Vacuum lines from individual stations shall be top-connected to the main vacuum header and be sloped to prevent entrained liquids from flowing back to other stations when the system is not in operation. The system shall be valved to permit sterilization of the entire system prior to entering the CVI header for maintenance of the pump. There should be adequate separation by filters of laboratory area from process area, and benchtop vacuum from Class III vacuum. The Government shall designate the autoclaves in the building that will be equipped to utilize ethylene oxide gas for sterilization purposes. Autoclaves so designated shall be connected to the CVA system as shown in Plate No. 3.4 and Plate No. B.1.

E. Process Air (PRA)

1. Purpose: Process air (PRA) is provided for use in the contaminated areas of the building. A PRA system will be required in buildings such as pilot plants and process development buildings.

2. Application: PRA is used only for service in direct contact with the interior of contaminated process equipment or systems.

3. Requirements:

a. Source: An independent supply shall be provided for the PRA system that shall be from an oil-free carbon or Teflon® ring compressor. Dew point, temperature, pressure, and flow rate shall depend upon the specific application.

b. Distribution: Prior to entering the vessel or other equipment where the air will come in direct contact with the agent, the air line shall be equipped with a bacterial filter and adequate valving to permit steam sterilization of the filter and the pipe downstream of the filter. The main air header shall be equipped with a bacterial filter downstream of the system pressure regulator with a shut-off valve between the filter and the pressure regulator to permit steam sterilization of the entire system.

F. Dry Process Air (DPRA)

1. Dry process air shall be supplied by passing process air (PRA) through a drier. For application, see 3-02 E.2.

2. The temperature, dew point, and flow rate shall be determined by the specific application.

3. For drier details, see 3-02 K.3.

G. Cold Water, Non-Contaminated Service (NCW)

1. Purpose: Non-contaminated cold water (NCW) is provided for use in the non-contaminated areas of the building except as noted below.

2. Application: NCW is used for lavatories, water closets, change rooms, showers, safety showers, and fire sprinklers in the non-contaminated and contaminated areas of the building. This service is not used for drinking water (see 3.02 P).

3. Requirements:

a. Source: The supply for this system shall be taken off the main header prior to the break-tank or back-flow preventer used for the CCW service. See Plate No. 3.5.

b. Measurement: Each building shall have a water meter on the main non-contaminated water supply.

H. Hot Water, Non-Contaminated Service (NHW)

1. Purpose: Non-contaminated hot water (NHW) is provided for use in the non-contaminated areas of the building except as noted below.

2. Application: NHW is used for lavatories and showers in the non-contaminated and contaminated areas of the building.

3. Requirements.

a. Source: NHW shall be supplied by a separate hot water heater supplied by the building NCW system. The tap for the supply system shall be after the NCW water meter.

b. Distribution: The hot water system shall be a closed-loop forced recirculating type.

I. Vacuum, Non-Contaminated Service (NVA)

1. Purpose: Non-contaminated vacuum service (NVA) is provided for use only in the non-contaminated area of the building.

2. Application: Non-contaminated vacuum shall be provided for benchtop use and in gas sterilizers in non-contaminated laboratories.

3. Requirements:

a. Capacity: Requirements at each outlet shall be 5 cfm at 20 inches of mercury vacuum unless otherwise specified.

b. Demand Factor: A demand factor of 10% of total connected load shall be used for design.

c. Distribution: Vacuum lines from individual stations shall be top-connected to the main vacuum header and sloped to prevent entrained liquids from flowing back to the stations when the system is not in operation. Headers whenever possible shall be sloped toward the source. If the requirement for NVA is limited that separate service cannot be justified, a tie-in to the general CVA system should be made and the NVA isolated with a pipeline bacterial filter. Discharge of air in this instance shall be as outlined above in 3-02 D.3.c.

J. Compressed Air (CA)

1. Purpose: The compressed air system (CA) provides general compressed air services for both the contaminated and non-contaminated areas of the building.

2. Application: Compressed air outlets are used on laboratory benches, in ventilated cabinets and in glassware washing room. (See 3-02 A.4 for additional locations.)

3. Requirements:

a. Source: The compressed air (CA) shall be supplied by an oil-free carbon or Teflon® ring type compressor. The compressor will operate intermittently to give 60 to 70 psig in the receiver, which will be reduced by a pressure reducing valve in the line after the receiver to maintain 40 psig at the most remote station.

b. Capacity: Requirements are 5 cfm at 40 psig at every station. A demand factor of 10% of total connected load will be used in general for design purposes. Spacing factors will be designated by the Government.

K. Dry Compressed Air (DCA)

1. Purpose: The dry compressed air system (DCA) provides service for the contaminated and non-contaminated areas of the building.

2. Application: DCA is supplied primarily for use in special Class III biological safety cabinet systems where humidity control is required (see Plate No. 6.1).

3. Requirements:

a. Source: DCA shall be supplied by passing air from the CA system through a suitable desiccant drier. The drier should be a fully automatic reactivating type with temperature limitation protection.

b. Capacity: Pressure, dew point, and rate shall be determined by the specific application.

L. Mask Air (MA)

1. Purpose: The mask air system (MA) is provided to supply breathing air for ventilated suits and head hoods used in the contaminated areas of the building.

2. Application: A minimum of three (3) MA outlets shall be provided in every room housing ventilated animal cages, aerosol tanks or chambers, and particularly hazardous apparatus such as spray driers, large lyophilizers, extraction columns, large filtration apparatus, centrifuges, mixers, agent filling machines, and any other equipment designated by the Government. At least one (1) room in each contaminated building shall be equipped with a minimum of three (3) outlets.

3. Requirements:

a. Source: The MA shall be provided by a system consisting of two (2) oil-free carbon or Teflon® ring type compressors and shall be cooled and free of water condensation. The receiver shall be sized

with sufficient reserve capacity to handle one-half of the system outlets for a period of five minutes. In cases where an existing water sealed compressor is used as the source for MA, a positive means of removing chlorine from the MA shall be provided. This can be accomplished by means of a silica gel air drier in the air stream or a carbon filter in the seal water line.

b. Capacity: The Government will furnish the air distribution system pressure, temperature, flow rate, dew point and demand factor required.

c. Distribution: Branch lines shall be taken from the top of the main header. Each branch line shall be provided with a shut-off valve at the header, a strainer before the manifold, a drip leg, and quick opening drain cocks. The manifold shall consist of ¼-inch half-couplings welded to the manifold on approximately three inch centers. Spring-clip type hose brackets shall be provided alongside each manifold and shall accommodate the same number of hoses as there are outlets on the manifold. Hose reels may be provided in mask air areas subjected to heavy traffic or where two or more people are required to work in the area for extended periods of time. Hose reels shall be the pull out and latch type with an adjustable hose tension feature and an emergency latch feature to prevent accidental rapid rewinding of the hose while still in use. Hose shall be 5/16-inch I.D. by 5/8-inch O.D. single braid red "beer" hose. Hook type brackets for supporting personnel hoods shall be provided in change rooms, air locks, or corridors.

d. Alarms: Low pressure alarms shall be provided locally.

M. Instrument Air (IA)

1. Purpose: The instrument air system (IA) is provided for use in both the contaminated and non-contaminated areas of the building.

2. Application: IA is used for the operation of pneumatically controlled instruments. It may also be used for the operation of pneumatic actuators, such as air cylinders, provided the proper oilers are added.

3. Requirements:

a. Source: IA shall be free of dirt. A standby compressor or tie-back to the compressed air system (CA) shall be provided to maintain service in the event of a breakdown of the main IA system.

b. Conditioning: The IA, where required, shall be dry and have a dew point of 0°F at atmospheric pressure.

c. Controls: A primary pressure regulator shall be provided after the receiver.

N. Propane Gas (PG)

1. Purpose: The propane gas system (PG) provides low-pressure gas to the contaminated and non-contaminated areas of the building.

2. Application: PG is supplied for laboratory bench tops, glassware washing tables, Class I biological safety cabinets, and Class III biological safety cabinets. The use of PG in Class III biological safety cabinets shall require the approval of the Fire Marshal and the Chief of Industrial Health and Safety. Wherever possible, the use of a portable gas cannister supply, alcohol lamps, or electric heaters is preferred to the use of the PG system in Class III systems. The PG system shall meet ASA requirements as outlined in the Z-21 series.

3. Requirements:

a. Source: PG shall be supplied by a storage tank system located on a concrete pad outside the building. The construction contractor shall not be required to furnish the propane storage tanks or the valving around the tanks. The tanks will be supplied by the Government and installed and piped by the company supplying the gas.

b. Demand Factor: A demand factor of 10% of total connected load shall be used for design purposes.

c. Distribution: The construction contractor shall be required to run the main PG header through the wall of the building to a point adjacent to the storage tank. A separate main shut-off valve shall be provided on the main supply line immediately after the line enters the building. The valve will be tagged in accordance with 3-07 D.2.

d. Controls: When the use of PG is approved in a Class III system, the supply line shall be equipped with an automatic or spring-loaded "dead-man" shut-off valve.

O. Steam (100-S, 60-S, 10-S)

1. Purpose: The steam system provides steam for the contaminated and non-contaminated areas of the building.

2. Application: Steam is supplied for use in such equipment as cage washers, glassware washers, heating coils, heat exchangers, and sterilizers and for use in the building heating and ventilating system.

3. Requirements:

a. Source: The supply to the building shall be from the central steam plant at 100 psig.

b. Distribution: The building main steam header shall be 100 psig Reduction to 60 or 10 psig on the branch lines shall depend upon the application. Steam traps shall be provided at low points in the steam distribution system and branch runouts and shall discharge to the condensate return line (NHC or NLC). Steam filters or strainers shall be installed prior to steam pressure reducing valves, temperature control valves, and steam seals and prior to the globe valve on lines used for the decontamination or sterilization of process equipment or piping.

Steam lines that tie into the jacket side of process equipment shall go through a steam trap to a flash tank, which shall vent to the atmosphere and discharge to a contaminated sewer line. If it becomes necessary to use the designations Contaminated High Pressure Condensate or Contaminated Low Pressure Condensate (CHC or CLC), such as the drain from steam seals, these services shall drain to the contaminated sewer system.

P. Drinking Water (LW)

1. Purpose: Drinking water (DW) is supplied for use in the contaminated and non-contaminated areas of the building.

2. Application: The DW system shall supply only drinking fountains.

3. Requirements:

a. Source: DW will be supplied by an independent system tapped off the main NCW header entering the building prior to any other tap on this line.

b. Distribution: The DW system shall be copper tubing from the system tap to the drinking fountains.

Q. Distilled Water (DIW)

1. Purpose: Distilled water (DIW) shall be provided for use in the contaminated and non-contaminated areas of the building.

2. Application: DIW may be supplied to laboratory sinks, glassware washing areas, and media preparation areas. Triple-distilled water is not considered a building service and will be produced by and stored in glass equipment where the requirements exists.

3. Requirements:

a. Source: DIW shall be provided by a single distilling system supplied by the NCW system. The still shall be fully automatic, steam heated, and equipped with a storage tank to hold 16 times hourly rate of the still.

b. Location: If possible, the DIW system shall be located to provide gravity flow throughout the building.

c. Limitations: In no case shall the building service steam condensate be utilized for distilled water.

R. Deionized Water (DMW)

1. Purpose: Deionized water (DMW) may be provided as a service to the contaminated and non-contaminated areas of the building. The necessity of supplying DMW as a building service will be determined by the Government.

2. Application: DMW may be supplied to process equipment, laboratory sinks, and media preparation areas.

3. Requirements: The size, type, and location of the deionizer shall depend upon the specific application and shall be supplied by the NCW system.

S. Decontaminant (T)

1. Purpose: Decontaminant (T) may be supplied as a service to the contaminated areas of the building.

2. Application: Piped decontaminant systems are usually limited to use in process areas. For a general discussion of decontamination methods, see Appendix B.

T. Nitrogen (N)

1. Purpose: A single nitrogen system may be provided to serve both contaminated and non-contaminated laboratory areas.

2. Application: Nitrogen is supplied primarily for use in special Class III biological safety cabinet systems where control of the composition of the environment is required (see Plate No. 6.1) and in process operations such as drying and milling.

3. Requirements: The nitrogen system shall be designed to withstand a primary pressure of 150 psig. All valving on the primary side shall be welded or screwed and back-brazed up to but not including the primary side of the pressure regulator. Secondary pressure regulators shall be either pilot or diaphragm operated piston type especially suited for this service.

3-03 PROCESS PIPING

A. General

1. Purpose: Process piping is used for the transfer of agent material and media between process or Class III equipment.

2. Application: The use of process piping is generally limited to process areas and is not found in laboratories.

3. Requirements:

a. Material: Product and slurry lines are constructed of stainless steel tubing. Valving shall be stainless steel body diaphragm valves with high temperature diaphragms.

b. Distribution: Process piping shall be installed for decontamination with 40 psig steam with steam inlets normally at high points in the line and drain at all low points to provide for complete sterilization and drainage. All horizontal runs shall slope in the direction of flow at least ¼ inch per foot. Pocketing shall not be permitted. All process piping shall be gastight by the halogen leak test (see 4-18, EQUIPMENT).

B. Steam Seals

1. All valves that are under a static head of liquid agent such as process or storage vessels shall be the steam washed type of diaphragm valve. On other lines connected to the tank, where isolation from another part of the system is desired, either a steam washed valve or a steam seal shall be used. The steam seal shall consist of two (2) diaphragm shut-off valves in the line with the space between the valves having steam supplied at the high point and containing a condensate drain at the low point (see Plate No. 3.6). In operation, the shut-off valves are closed, the steam is opened wide, and the condensate drain is slightly opened or "cracked" to effect a steam block between the two shut-off valves. The steam, condensate, and air resulting from the steam seal shall be directed to the contaminated waste system.

2. On steam seals used to protect or maintain product integrity, the valving for the steam to the seal shall consist of a reverse globe valve so that steam pressure is on the valve stem packing, followed by a diaphragm valve (see Plate No. 3.6). The drain valve shall also be a diaphragm valve.

3. Steam seals used for safety purposes, such as those on contaminated waste lines where product integrity is not considered, shall be supplied steam by a globe valve that is installed in reversed position to normal flow to place steam pressure on the valve packing at all times. A diaphragm valve will not be required on the steam line. The condensate valve shall be the diaphragm type.

3-04 WASTE PIPING

A. General

1. Three major categories of liquid wastes are handled on the site, storm sewage, sanitary sewage, and contaminated sewage. The storm sewage is used for the conventional rainwater run-off. The sanitary sewage normally handles sanitary sewage from non-contaminated areas of the building and is treated in a conventional sewage treatment plant. The contaminated sewage is collected from the various drains in the contaminated

areas of the building and is treated in a central sterilization plant prior to discharge to the conventional sanitary sewage system.

2. Sewage from a non-contaminated area may be discharged into a contaminated sewage line on the sole basis of engineering considerations of convenience and cost.

3. Toilets, lavatories, floor drains, shower drains, etc., in contaminated change rooms may normally drain to the sanitary sewage system. However, in some specific high risk areas such as pilot plants, etc., floor drains may be required to go to the contaminated sewage system. In the latter case, specific decisions will be made by the Government.

4. Drains from air conditioning units, overflow on distilled water stills, compressor cooling water, etc., shall discharge to the sanitary or storm sewer whenever possible.

5. Laboratory rooms that are intended to be convertible from non-contaminated to contaminated (1-03 L, ARCHITECTURAL) shall drain to the contaminated sewer.

6. Sump pumps in non-contaminated areas should discharge to the sanitary sewer if available, otherwise to the contaminated sewer (never to the storm sewer). Sump pumps in blowcase rooms and other contaminated areas should discharge to the contaminated sewer.

B. Application

1. Special Equipment: There shall be drains from the following special equipment: Class I biological safety cabinets, Class III biological safety cabinets, chemical fume hoods, cage service cabinets, and others as required.

2. Manifolding: Biological safety cabinets that are joined together and are not separated by air locks or doors may have a common manifolded drain system with a single drain valve and trap on the manifold. Individually segregated sections of a cabinet array shall contain separate drains, valves, and traps.

3. Radiological Laboratories: Drains from sinks, radiological fume hoods and any other equipment in rooms that handle radioactive isotopes shall be disconnected from the waste drain system to prevent any discharge of waste, except for sterilizers, which shall discharge to the contaminated waste system. Liquid wastes produced in these rooms shall be collected in containers for disposal in accordance with the Fort Detrick Radiological Safety Manual, Dec 63. Approval for any open drains in such rooms must be given by the Chief, Industrial Health and Safety Office.

4. Walk-In Refrigerators and Incubators: All walk-in refrigerators and walk-in incubators shall be provided with one (1) floor drain located as near to the back as possible.

5. Rooms and Corridors: All rooms and corridors, including attic and basement, shall be provided with one (1) or more floor drains located as near the center of the room as possible. These drains shall be arranged so that they may be used as drains or, if so desired, a screw-type plug may be inserted, thereby sealing the drain.

6. Non-Contaminated Offices: Non-contaminated offices and corridors shall in general not be provided with floor drains unless there is a possibility of future conversion to laboratory use (see 3-04 A.5). Where drains are installed in these rooms, they shall be plugged.

7. Plenum Chambers

a. Air Supply Plenum: A metal pan may be substituted for the concrete floor of the air supply plenum after the entry louvers and the preheat coils. The plenum shall be equipped with a drain. This drain and the cooling coil drain shall be discharged to the storm water drain or carried outside the building and discharged.

b. Air Exhaust Plenum: A metal pan may be substituted for the concrete floor of the exhaust plenum, between the main air exhaust duct connection and the deep bed filters. The plenum shall be equipped with a drain, trap, and diaphragm valve. The trap shall be deep enough to prevent negative pressure of the plenum from pulling the trap. The drain line shall be connected to the contaminated sewage system and shall have the diaphragm valve installed in the horizontal section of the line after the trap.

8. Equipment Rooms: In equipment rooms, glassware washing rooms, and cage washing rooms, additional floor drains shall be installed as necessary to service all drain lines, blow down systems, overflows, etc., that are an integral part of the piping for such equipment. These drains shall be in addition to the general floor drains in equipment rooms.

9. Air Locks: Air locks shall have no floor drains; however, the floor shall slope toward the more contaminated room or corridor for drainage purposes.

C. Separation of Drains

1. Closed and Open Equipment: Drains from each piece of closed equipment such as Class III biological safety cabinets shall drain directly to the main contaminated waste header outside the building through a separate header intended only for this purpose. They shall not tie into drain lines from open equipment such as sinks and floor drains.

2. Between Floors: Cross connection of contaminated plumbing lines between attic, upper, first, or basement floors shall not be allowed. All drain lines from each floor of a contaminated building shall go to the contaminated sewer in a closed system.

D. Floor Drain Details

1. Sizing: Floor drains shall be 4 inches in diameter.

2. Type of Drain: Floor drains, in general, shall be non-clog bucket-type drains (Josam 300-35C series or approved equal) and be equipped with 10-inch catch pan and adjustable strainer height.

3. Automatic Trap Priming: Automatic trap priming shall be provided to all floor drains to insure that they will remain sealed.

4. Threaded Plugs: Floor drains shall be supplied with screw type plugs which may be inserted if the drain is not required.

5. Animal Rooms: Floor drains in animal rooms shall be non-clog bucket-type drains (Josam 3740 series or approved equal) and be equipped with 10-inch catch pan and adjustable strainer height.

6. Trenches: Floor trenches shall not be used in such a way as to permit open flow of contaminated liquid waste.

E. Drain Line Details

1. Guide Specification: See Appendix C, services CCD, NCD, CV, and NCV.

2. Buried Lines

a. Minimum Size: All drain lines beneath floor slabs on grade shall be not less than 4 inches in diameter.

b. Covering: For protection and identification purposes, all underground contaminated sewage lines, except lines under buildings, shall be placed in a trench and covered all around with a minimum of 6 inches of concrete measured from the surface of the pipe.

c. Type of Pipe: Buried drain lines shall be extra heavy cast iron soil pipe, bell and spigot joint, and lead sealed.

3. Lines from Closed Equipment: All drains from equipment closed to the room such as biological safety cabinets, Class III, shall be Schedule 40, welded, wrought iron pipe.

4. Lines from Open Equipment: All drains from sinks, sterilizers, and chemical fume hoods open to the room (except floor drains) shall be screwed fittings to a point immediately after the trap; thereafter, the lines shall be Schedule 40 welded wrought iron pipe.

5. Floor Drain Lines: Floor drain traps and drain lines shall be Schedule 40, welded, wrought iron pipe when exposed.

6. Vent Lines to Drains: All vent lines from sinks, sterilizers, floor drains, etc., shall be Schedule 40, welded, wrought iron pipe.

F. Vents

1. General: The infectious hazard associated with various contaminated waste lines varies widely, depending upon the source of the waste, its previous treatment, and the amount handled. Repeated testing has established that the majority of contaminated waste lines may be safely vented directly to the atmosphere without filtration. Vents from waste lines carrying highly toxic or infectious materials such as from fermentors and waste collection treatment tanks must be routed to incinerators. Where questions of vent routing arise, the final decision will be made by the Government.

2. Cross Connections: There shall be no cross connection of vent lines from different floors. Each floor shall be vented separately. Vents from the same floor shall be tied together in the attic, then run through the roof as a single vent, with filter adapter, shut-off valves, and steam connection to the pipe line filter.

3. Special Tests: Upon completion of all vent piping systems, a separate smoke test shall be made of both contaminated and non-contaminated vent systems to insure against cross connections in these systems. This test shall be performed by the contractor in the presence of the contracting officer or his representative.

4. Contaminated Vent to Incinerator

a. Applications: See 2-08 A, HV&AC.

b. Pipe: Pipe shall be carbon steel conforming to ASTM A-53. Pipe shall be Schedule 40 for sizes six (6) inches and below; Schedule 20 for sizes eight (8) inches to twelve (12) inches inclusive; and Schedule 10 for sizes fourteen (14) inches and larger.

c. Fittings: Unless otherwise indicated, fittings shall be butt-welded type. Elbows shall be long radius type with minimum 1½ radius bend. Standard weld reducers shall be used for pipe sizes up through six (6) inches. The included angle of reduction between opposite walls of the notched pipe shall not exceed 30 degrees. Ells eight (8) inches and larger may be five-piece miter with minimum 1½ radius bend.

d. Valves: Valves shall be diaphragm type with cast steel body and high temperature diaphragm.

e. Branch Connections: All connections of branches to mains shall be made at a 45-degree angle for streamline flow. Connections of risers into the main shall be made by looping the branch into the top of the main.

f. Seals Around Penetrations: For seals around pipes passing through walls and floors see 1-05 E, ARCHITECTURAL.

g. Pipe Line Filters: Pipe line filters shall be required in all contaminated vent line headers between last connection and atmosphere, except those from Class III safety cabinets where the individual cabinet or cabinet system is provided with an individual HEPA exhaust filter (see 2-06 D.6, HV&AC). Pipe line filters shall be high-efficiency type (see 2-09 C). (See Plate No. 3.4.)

G. Valves

Diaphragm valves shall be used in contaminated drain and vent lines. Installation of diaphragm valves shall be as in 3-02 A.2.b. In cases where a heavy load of solids may be expected, such as in animal rooms, the straight-through type of diaphragm valve may be used.

H. Sterilizers

1. Equipment: See 4-06 EQUIPMENT, for details on sterilizers.

2. Drainage: Waste lines from sterilizers shall discharge into a contaminated sewage line, which shall be a branch line from a main serving other similar drains. Screwed connections shall be used up to and including the union after the steam trap. After the union, the lines shall be welded. (See Plate No. 3.4 for schematic of waste piping.)

3. Venting: All sterilizers (including rupture discs and safety valves) directly connected to equipment such as biological safety cabinets, aerosol chambers, etc. must be vented in a manner identical to the equipment to which they are connected as far as filtration and incineration are concerned, except that the sterilizer exhaust will not be filtered before tying into the manifold or main vent header. The vent line for the sterilizer drain shall be tied into the drain line before the trap (see Plate No. 3.4). The drain line after the trap can be vented through a regular plumbing vent. Vents on sterilizers shall be of sufficient size so that upon exhaust, the trap in the drain line will not be blown.

a. Sterilizers Attached to Class III Safety Cabinets: Biological safety cabinet, Class III, sterilizer vents and safety valve discharge shall discharge by separate lines to the main CVI header, which in turn discharges to a central incinerator. Vent lines

shall be properly sloped for drainage. These lines shall not tie into the exhaust line from the biological safety cabinet. If a building does not have a vent system connecting to a central incinerator, the vent from the sterilizer shall tie into the exhaust from the biological safety cabinets in the building attic between the cabinet outlet bacterial filter and the electric air sterilizer (see Plate No. 3.4).

b. Other Sterilizers: The vent from other sterilizers in contaminated areas not connected to Class III safety cabinets and not free standing, i.e., those connecting two rooms or those connected to Class I safety cabinets, shall be carried individually to the attic where they shall top-connect to a manifold or main vent header. This manifold shall exhaust into the building exhaust filter chamber after the pre-filters, if any, and ahead of the deep bed filters (see Plate No. 3.4). The manifold shall be sized so that its pressure will not differ appreciably from that in the building exhaust filter chamber, and shall be equipped with a trap to keep moisture out of the building exhaust system. Vents from free standing sterilizers shall discharge directly to the atmosphere through the roof.

I. Waste Collection Treatment Units

1. General Criteria

All liquid waste leaving an infectious disease laboratory or process building must be sterilized by the Post Sewage Sterilization Plant. In addition, when large amounts of infectious material as from large fermentors, holding tanks, and aerosol chambers are to be disposed of, a waste collection treatment unit shall be interposed so as to "pasteurize" (reduce the number of viable organisms) or to sterilize the waste before discharge to the Post Sewage Sterilization system.

A local waste collection treatment system is not needed in a building in which the largest unit container is five (5) gallons. In these buildings waste can be discharged directly to the Post Sewage Sterilization system.

Determination for the requirement of a separate waste collection treatment unit shall be made by the Government prior to the preliminary design phase. The contaminated sewage system includes a special central sterilization plant to render agent material sterile prior to discharge into the conventional sanitary sewage plant.

When treatment of liquid effluents is required, a waste collection treatment unit shall be designed in accordance with either 2.a, 2.b, or 2.c below. The type of treatment unit shall be specified by the Government.

When pasteurization is allowed, waste collection treatment units shall be designed for continuous operation at 200°F with a retention time of at least one minute; however, provision shall be made for future use of units for batch sterilization.

2. Method of Operation

a. Batch Sterilization Type: Plate No. 3.7 gives a diagram of a batch sterilization type installation. Operation is manual (for controls, see 6-02 C, INSTRUMENTATION). Liquid waste is heated by injection of live steam at 40 psig and held at temperature (287° F) for a given period. The spargers shall be constructed of corrosion resistant material capable of withstanding steam and decontaminants (see Appendix B). The vessel may then be cooled by a water spray before release of pressure and discharge of treated waste to the contaminated sewer line. The use of the cooling spray is optional.

b. Pasteurization Type: Plate No. 3.8 gives a diagram of a continuous, high temperature pasteurization type installation. Operation is automatic (for controls, see 6-02 C, INSTRUMENTATION). Waste is maintained at 200°F by injection of live steam. The waste discharges continuously, by gravity, through a retention tube immersed in the bulk liquid. The tube is provided to avoid the danger of short circuiting, and is designed for a minimum residence time of 1 minute.

c. Continuous Flow, Heat Exchanger Sterilization System: Plate No. 3.9 is a schematic sketch of a continuous flow, heat exchanger sewage sterilization system. This system is the preferred system for sterilizing large volumes of liquids as from several laboratory buildings. However, the heat exchanger sterilization system is flexible and because this system has a number of distinct advantages over the tank sterilization systems, it may be the system of choice even when volume flows are quite small. The procurement and installation costs of the heat exchanger system are relatively high, but operating costs are very low. The heat exchanger system is ideally suited to short term heat treatment of a liquid. The contaminated, low temperature sewage picks up heat from the high temperature sterile sewage so that only relatively small amounts of heat would be added to bring the system to operating temperatures. The sterile sewage is cooled to a point where it can be readily discharged from the system. Liquids from the laboratory areas are drained by gravity into a holding tank. A comminutor may be placed in the drain line before the line empties into the holding tank or tanks. When sufficient volume has accumulated, the system will be started by operating the two (2) circulating pumps. Steam will be added through the steam injector and the outflow of treated sewage will be bypassed back into the holding tank instead of discharged to the sanitary sewer until full operating temperatures have been reached. When operating temperatures have been reached, the treated sewage will be switched back to discharge to the sanitary sewer. A second pump located after the retention tubes but before the second pass through the heat exchangers is essential. This second pump raises the pressure of the treated sewage so that if there is a leak between the tube and shell side of the heat exchanger it will be sterile sewage into contaminated sewage, not contaminated sewage into treated sewage. A rubber diaphragm type of sampling adapter should be placed on the discharge line and samples taken at intervals to check on the sterility of the treated sewage.

The temperatures desired throughout the system as well as the retention time and per cent of heat recovery can be varied by the design and materials of the system.

3. Capacity

a. Batch Sterilization Type: The vessel shall be of sufficient volume to hold the liquid waste from all the connected equipment for a twelve (12) hour period. One basis for sizing of minimum capacity is: total working capacity of all chambers and safety cabinets plus 25% of this capacity to take care of condensed steam and other waste.

b. Pasteurization and Heat Exchanger Types: The capacity of the holding vessel can be the same as above for batch operation except the time period should be eight (8) hours.

c. Two Holding Vessels: When an individual building treatment system is of the batch type, two (2) holding vessels shall be used.

4. Design Criteria

a. General: A primary and most important component of waste collection treatment units is the location and consistency of valves and equipment so as to facilitate operation, maintenance, and safety. In the primary design of the system, important items of maintenance and safety should be considered to keep downtime at a minimum, with performance and safety at a maximum. Easy access to replacement parts such as valves, diaphragms, and long probes is essential.

b. Location: Waste collection treatment units shall be located in rooms separated from the operating equipment that they service (see also 1-01 C.3, ARCHITECTURAL).

c. Water-Tight Pit: Waste collection treatment units shall be installed in a water-tight concrete pit large enough to hold the contents of the blowcase if the pit drains are blocked in conjunction with rupture of the blowcase.

d. Anchors: Waste collection and treatment tanks shall be securely anchored to prevent floating in the event that pit drains become blocked and the pit fills with water.

e. Treatment Tank: Treatment tank shall be designed for operating pressure and full vacuum and meet the requirements of the lethal vessel section of the ASME unfired pressure vessel code.

f. Retention Tube: Retention tubes should be located inside the waste collection treatment unit and shall be constructed of corrosion resistant material capable of withstanding steam and decontaminants (see Appendix B).

g. Sealing and Leak Testing: Where possible, all joints shall be of welded construction. Where it is necessary to use flange and gasket joints such as on pumps, ejectors, and heat exchangers, a halogen leak test (see 4-18, EQUIPMENT) of the waste collection treatment system shall indicate no leakage at maximum operating pressures. If the system is insulated, access shall be provided to all valves and flanges to permit future halogen leak testing.

h. Wall Finish: The interior surfaces of rooms in which waste collection treatment units are located shall be resistant to high humidity, high temperature, and decontaminating agents. See Section 1-05 B, ARCHITECTURAL for details on wall finishes.

i. Ventilation: Waste collection treatment unit rooms shall be ventilated. See 2-05 E, HV&AC for details.

j. External Controls: When specified by the Government, provision shall be made for operating control system external to the waste collection treatment unit enclosure or room.

5. Venting (CVI)

a. Vent lines from waste collection treatment units shall discharge into a separator or condenser that discharges through a vent header into an incinerator.

b. See 3-04 P 4 for details on CVI vent system.

6. Drainage

a. Inlet Lines

(1) Lines to waste collection treatment units shall be Schedule 40, welded wrought iron lines. Diaphragm valves (see 3-04 G) shall be used in such lines.

(2) The waste collection system should be designed to operate by gravity flow to the collection tank by sloping the pipe a minimum of ¼ inch per foot in the direction of flow.

(3) Highly contaminated, all welded lines running to waste collection treatment units shall be suitably marked for easy identification. All lines shall be marked according to color code (see 3-07) with paints or markings resistant to all decontaminants.

b. Drain Lines

(1) Drain lines from waste collection treatment units shall have a diaphragm valve (see 3-04 G) and shall not be connected to any other lines inside the building except lines from other waste collection treatment units.

(2) Drain lines from waste collection treatment units shall discharge directly to main contaminated drain line headers outside the building.

c. Room Drain: Waste collection treatment unit rooms shall have natural drainage to the contaminated sewer system; otherwise they shall drain to an open sump with both a sump pump and steam jet ejector for discharge to the contaminated sewer system.

7. Controls

For information on the instrumentation and controls for waste collection treatment units, see 6-02 C, INSTRUMENTATION.

3-05 FIRE SPRINKLERS

A. Criteria for Use

1. New Buildings: Although this manual prescribes minimum use of wood and other combustible materials of construction, it does not call for fireproof construction (see 1-04 D, ARCHITECTURAL). Therefore a water sprinkler system is to be installed in all new buildings, subject to approval by the Government.

2. Conversions: In altering contaminated laboratories, sprinkler systems shall be provided where none exist.

B. Technical Features

1. Fire protection sprinkler systems shall be designed in accordance with National Fire Protection Association Pamphlet No. 13, "Standards for Installation of Sprinkler Systems" (also issued as NBFU 13).

2. To provide maximum available pressure, water used for fire sprinkler systems shall be tapped off the street main and run to the building as a separate supply.

3. The selection of fog nozzles shall be made with proper consideration given to such factors as physical character of the hazard involved, draft or wind conditions, material likely to be burning, and the general purpose of the system. Because of biological hazards, fog nozzles shall be provided.

C. Fire Hose Access: A penetration shall be provided in at least one exterior wall of the contaminated area for a fire hose access port. This opening shall be a capped pipe sleeve installed in the wall, which may be opened to allow firemen to pass a fire hose directly into the contaminated area of the building without having to traverse the change room labyrinths.

D. Sprinkler Alarm System

1. Central Alarm: Operation of any part of the sprinkler system shall activate an alarm in the central firehouse.

2. Branch Alarms: Branch alarms shall be installed in each main corridor and wing of each building, activated by flow in branches of the sprinkler header system.

3. Fire Detection and Alarm System

a. Conversions: In buildings erected previously without a sprinkler system (see 3-05 A above), a fire detection and alarm system was provided. If sprinkler systems are installed during the alteration of such buildings, the Government will determine the disposition of the existing fire detection and alarm systems.

b. New Buildings: A separate fire detection and alarm system shall not be provided in new buildings unless specifically called for by the Government.

c. Reference: See 5-08, ELECTRICAL, for criteria for the fire detection and alarm system.

E. Flammable Material Storage: See Section 1-03 J, ARCHITECTURAL.

3-06 INSULATION

A. General

1. All insulation that is subject to mechanical abuse shall be adequately protected.

2. See 2-10 E, HV&AC for insulation requirements for HV&AC equipment and ducts.

3. Standard commercial insulation and practices shall be used in the non-contaminated areas.

4. For both contaminated and non-contaminated areas, all insulation materials shall have a surface flame spread rating not higher than 25 without evidence of continued progressive combustion, and shall be of such composition that surfaces exposed by cutting through the material in any way shall have a flame spread rating not higher than 25 without evidence of continued progressive combustion. Smoke generation rating shall not exceed 50. (Flame spread and smoke generation ratings as used herein refer to ratings obtained according to the "Standard Test Method for Fire Hazard Classification of Building Materials," ASTM E84 NFPA No. 255, UL Standard.) These limitations shall not apply on piping or equipment when the insulation materials are sheathed in stainless steel.

B. Special Criteria for Contaminated Areas

1. Piping should be routed, and equipment located, so as to minimize the use of insulation with due regard for cost and functional requirements.

2. Where burn protection only is needed, the possibility of using fenders instead of insulation should be considered. For hot water, steam, and condensate piping, full-length burn protection shall be provided in pipe chases.

3. Insulation shall be finished with materials that will withstand the decontamination procedures for the given area, and will retain a firm, smooth, crack-free outer surface impermeable to moisture.

4. Insulation shall be fabricated of non-organic materials and shall be of a type to prevent biological migration (closed-cell, reflective, etc.). In the event of damage to the finish material, the insulation shall not deteriorate when directly exposed to decontamination procedure. If insulation is metal sheathed, both of these requirements may be waived.

5. Insulation for process piping (rarely used), or for any other line to be halogen leak tested, shall be applied after testing and shall not cover potential pipe leak spots such as screwed fittings.

6. Insulation used in any room in which equipment must undergo halogen leak testing shall be fabricated of non-halogen liberating material (see 4-19, EQUIPMENT). Where insulation is enclosed in a gas-tight sheath preventing escape of halogens, or is for refrigerators (see 4-03 C.3, EQUIPMENT), this requirement may be waived.

7. Equipment or piping potentially subject to leaks shall have an insulation system unaffected by the leaking material. (For example, polystyrene shall not be used over equipment or piping handling trichlorethylene.)

8. Seals around insulated lines passing through walls separating areas of different levels of contamination and through floors or ceilings in contaminated areas shall be provided in accordance with sub-section 1-03 E, ARCHITECTURAL (Plates No. 1.15, 1.19, and 1.20).

3-07 MARKING AND COLOR CODE

A. Pipe Line Symbols and Color Code: Table 3.1 lists the symbols and color code for the various piping services, including process and waste.

B. Standard Military Code: The standard military color code shall be used as specified in MIL-STD-101A, 16 March 1954, "Color Code for Pipelines and Compressed Gas Cylinders," and AR 385-30, 16 August 1965, "Safety - Safety Color Code Markings and Signs" (Cylinders and Pipe

Lines). This includes colors, stenciling of panels, and metal tagging of valves. Terminal cocks shall be marked by stencil or names on stop cock handle; lines shall be stenciled at the point of entrance into a room, and at least once every fifteen (15) feet in continuous span and at turns and junctions (see Plate No. 3.10).

1. The use of decals or tape, instead of paint, is approved provided that appropriate colors are used and that the decals or tape are compatible with the decontaminating agents used in the contaminated portions of the building.

2. Luminous paints should be considered for color coding lines and marking valves in attics, for improved visibility.

C. Biological Hazard Warning Symbol: A universal, USPHS approved biological hazard warning symbol shall be used to identify areas such as entrances to certain laboratories and animal rooms and equipment such as refrigerators, incubators, and deep freezers used with infectious materials.

1. Scope: The biological hazard warning symbol (biohazard symbol) specified herein shall be used to signify the actual or potential presence of a biohazard and to identify equipment, containers, rooms, materials, experimental animals, or combinations thereof that contain or are contaminated with viable hazardous agents.

For the purpose of this standard, the term "biological hazard" or, synonymously, biohazard, shall include only those infectious agents presenting a risk or potential risk to the well-being of man, either directly through his infection or indirectly through disruption of his environment.

The standard does not specify a minimum hazard level for which the symbol shall be used.

2. Symbol: The biohazard symbol for signifying biological hazard as defined in the scope of this standard shall be designed and proportioned as illustrated on Plate No. 3.11.

The symbol shall be as prominent as practical and of a size consistent with the size of the equipment or material to which it is affixed, provided that the proportions shown are maintained, and, in any case, that the symbol can be easily seen from as many directions as possible.

Except when circumstances do not permit, the symbol shall be oriented with one of the three open circles pointed up and the other two forming a base.

3. Color: The symbol design shall be a fluorescent orange or orange-red.* Background color is optional as long as there is sufficient contrast for the symbol to be clearly defined.

4. Restrictions: The biohazard symbol shall be used or displayed only to signify the actual or potential presence of biological hazard as provided in the scope of this standard.

Appropriate wording may be used in association with the symbol to indicate the nature or identity of the hazard, name of individual responsible for its control, precautionary information, etc., but never should this information be superimposed on the symbol.

*Day-Glo® Fire Orange of the Switzer Brothers, Inc., is cited as an example, not an endorsement.

D. Metal Tagging of Valves: All valves on all lines shall be tagged as follows:

1. Contaminated Service and Process Lines: All valves on contaminated service and process lines shall be tagged with a star-shaped tag, wired to the valve. Tags shall be of enameled steel, brown, and with the line symbol stamped thereon (i.e., CCP, etc.).

2. Non-Contaminated Service Lines: All valves on non-contaminated service lines shall be tagged with a round tag, wired to the valve. Tags shall be of plain aluminum and uncolored with the line symbol stamped thereon (i.e. DW, etc.).

E. Marking Lines Entering or Leaving a Building

A metal plate shall be attached to the outside wall of a building immediately above the point where a line enters or leaves the building. This plate will give the type of service, the size of the line, and the depth of the line.

TABLE 3.1

Marking and Color Code (3-07 A)

Symbol	Basic Band Color	Secondary Arrow Color	Service
100-S	Gray	Gray	Steam - 100 psig
60-S	Gray	Gray	Steam - 60 psig
10-S	Gray	Gray	Steam - 10 psig
NHC	Gray	White	High Pressure Condensate 60 psig and Above, Non-Contaminated
CHC	Gray	Brown	High Pressure Condensate, Contaminated
NLC	Gray	White	Low Pressure Condensate Below 60 psig, Non-Contaminated
CLC	Gray	Brown	Low Pressure Condensate, Contaminated
DW	White	White	Drinking Water
NCW	White	[illegible]	Cold Water, Non-Contaminated
CCW	Brown	[illegible]	Cold Water, Contaminated
NHW	White	White	Hot Water, Non-Contaminated
NHW-R	White	White	Hot Water Return - Non-Contaminated
CHW	Brown	Brown	Hot Water, Contaminated
CHW-R	Brown	Brown	Hot Water Return, Contaminated
ACW	White	White	Air Conditioning Water
ACW-R	White	White	Air Conditioning Water Return
DIW	White	White	Distilled Water
DMW	White	White	Deionized Water
N	Gray	Black	Nitrogen
HDC	Black	Black	Hydraulic Lines
CA (Old Symbol, CPA, NPA)	Gray	Green	Compressed Air
DCA	Gray	Green	Dry Compressed Air
IA	Gray	Green	Instrument Air
MA	Gray	Green	Mask Air
PG (Old Symbol, CPG, NPG)	Yellow	Yellow	Propane Gas (formerly Pyrofax Gas)
NVA	Gray	Gray	Vacuum, Non-Contaminated
CVA	Brown	Gray	Vacuum, Contaminated
CCD (a)	Brown	Brown	Drain, Contaminated
NCD (b)	No Color	No Color	Drain, Non-Contaminated
NV	Gray	Gray	Vent, Non-Contaminated
CV (c)	Brown	Brown	Vent, Contaminated

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TABLE 3.1 - Continued

Symbol	Basic Band Color	Secondary Arrow Color	Service
CVI	Brown	Brown	Vent, Contaminated to Incinerator
T	Gray	Gray	Decontaminant Lines
FRE	Gray	Gray	Freon
BC	6" Brown Band - BC Stenciled in Black on Band	Orange	Blowcase Line (Waste Collection Treatment)
SW	White	White	Storm Water
CULT (c)	Blue	Gray	Product
MED	Pink	Pink	Slurry
GLUC	Black	Black	Glucose Solution
HYD	Tan	Tan	Hydrolysate
PRA	Gray	Brown	Process Air
DPRA	Gray	Brown	Dry Process Air
ACID	Blue	Blue	Acid
ALK	Blue	Blue	Alkali
CWS	Brown	Brown	Tower Water Supply
CWR	Brown	Brown	Tower Water Return
CWS-60 (d)	Brown	Brown	60° Cooling Water Supply (d)
CWR-60 (d)	Brown	Brown	60° Cooling Water Return (d)
RCWS-35 (d)	Brown	Brown	35° Refrigerated Water Supply (d)
RCWR-35 (d)	Brown	Brown	35° Refrigerated Water Return (d)
TWS-H	Brown	Brown	Tempered Water Supply
TWS-C	Brown	Brown	Tempered Water Supply
TWR	Brown	Brown	Tempered Water Return

NOTE: On insulated lines, code is to be applied on insulated portion.

(a) When used in process area secondary arrow color is gray, and symbol is placed on 4-inch orange band.

(b) When used in process building, colors are black and black.

(c) When used in process area, symbol is placed on 4-inch orange band.

(d) Other temperatures may be specified.

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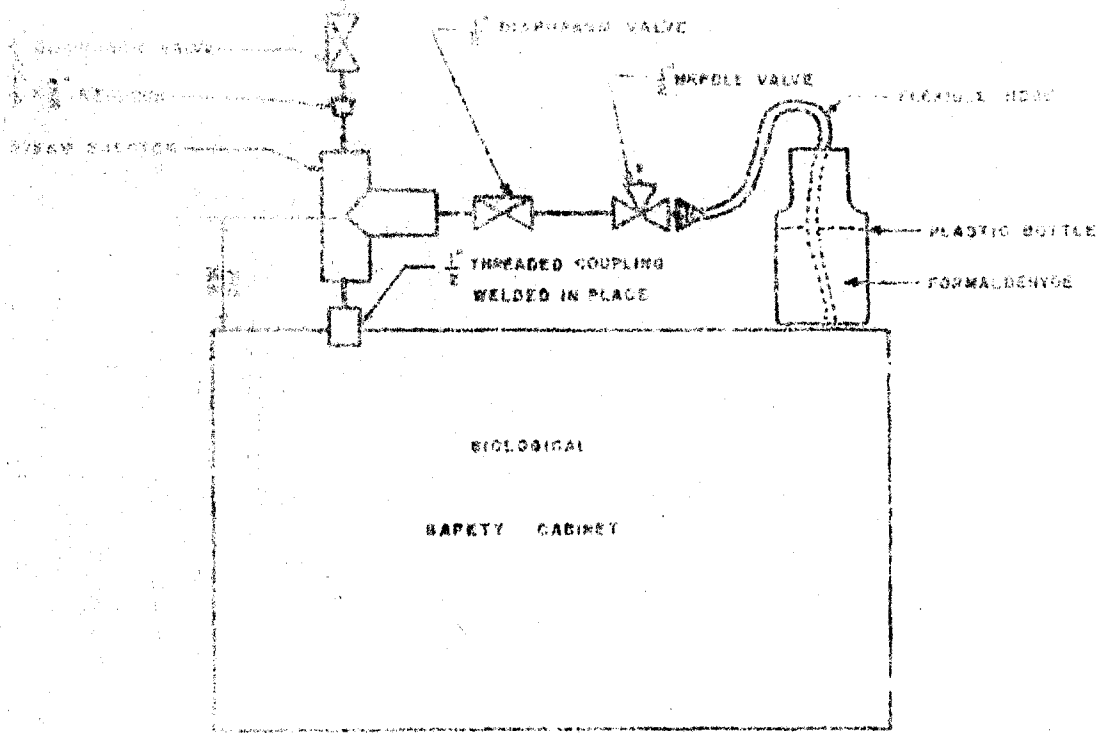
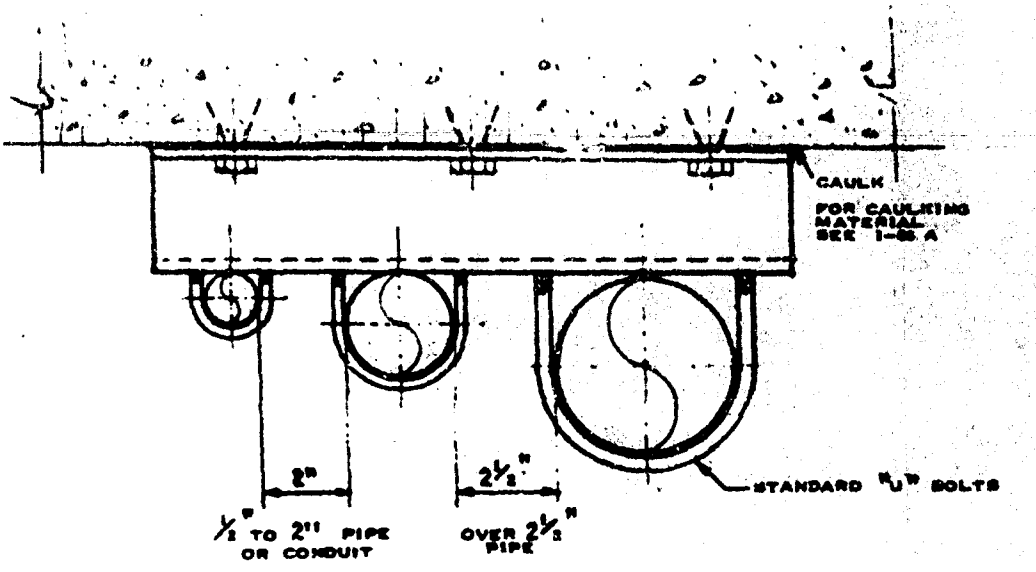
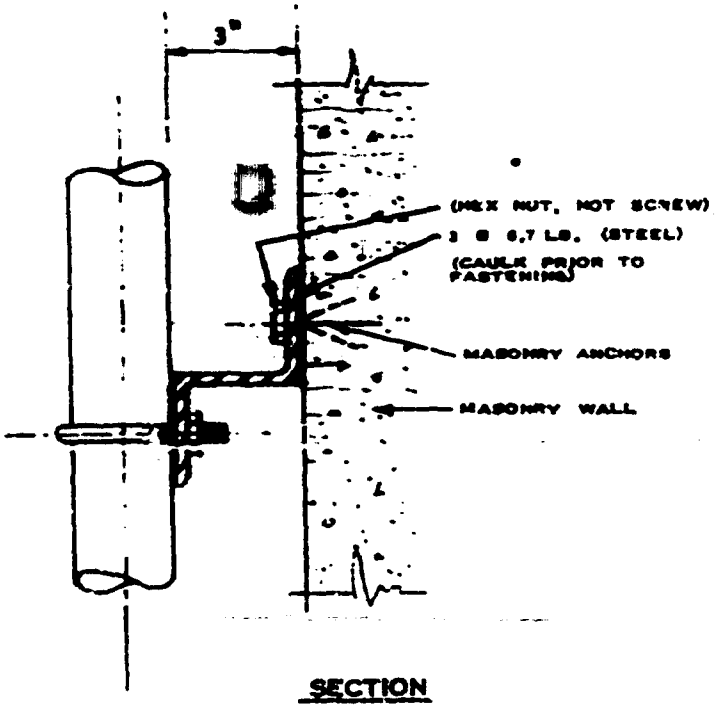


SERVICE PIPING FOR STERILIZATION OF CABINETS WITH STEAM-FORMALDEHYDE	⚠	8/67	GENERAL REVISION
	REV.	DATE	DESCRIPTION
	DATE - 1 FEB 66		PLATE NO. 3.1



PLAN



SECTION

TYPICAL PIPE AND CONDUIT WALL SUPPORT DETAIL	REV.	DATE	DESCRIPTION
		CATE - 1 FEB. 66	PLATE NO. 3.2

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REDUCED PRESSURE BACKFLOW PREVENTER

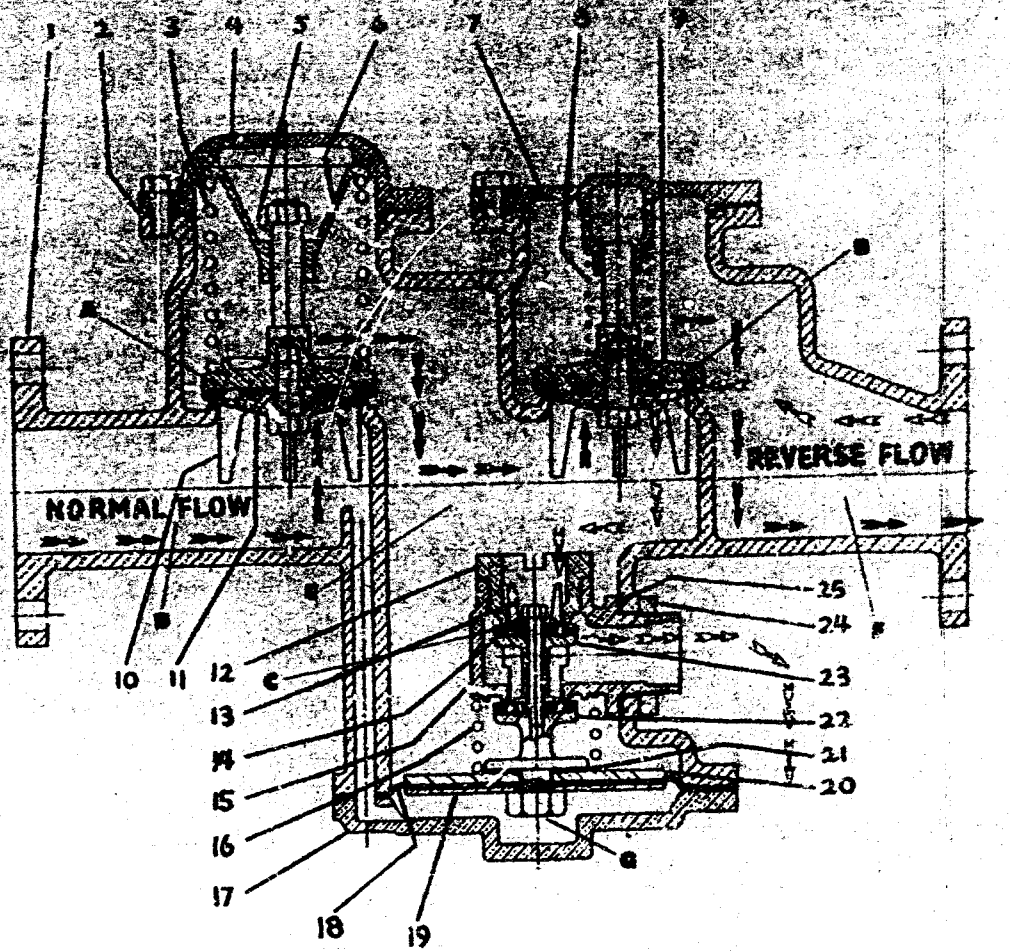
PLATE NO. 33

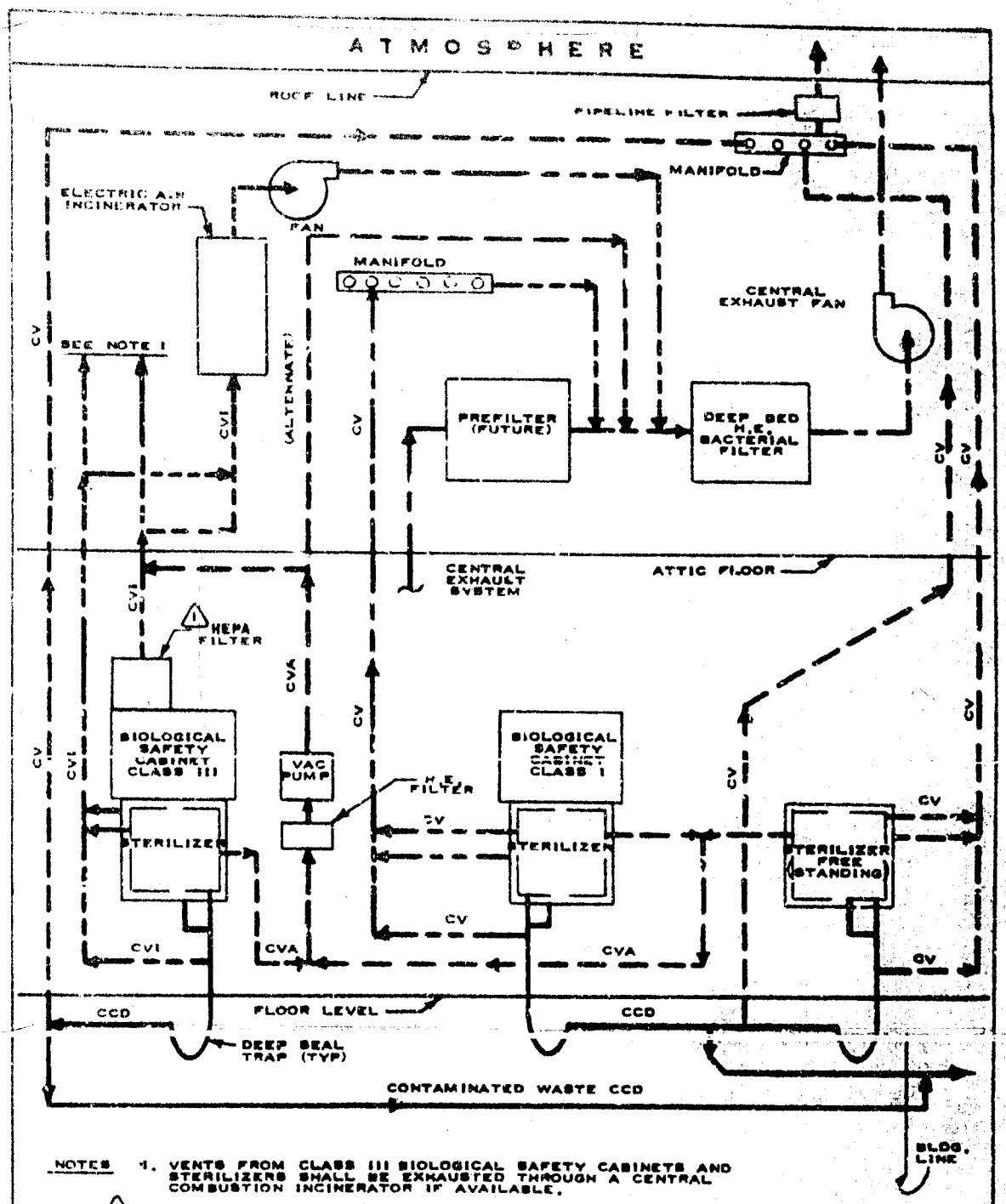
DATE - 1 JULY 67

REV.	DATE	DESCRIPTION

PARTS LIST FOR 3" SIZE
OTHER SIZES VARY SLIGHTLY

1. Bolt
2. Cover Plate Gasket
3. Main Valve Spring
4. Main Valve Cover
5. Main Valve Seat Holder
6. Main Valve Seat Retainer
7. Check Valve Seat
8. Check Valve Spring
9. Check Valve Seat Holder
10. Main Valve Seat Guide
11. Main Valve Rubber Valve Disc
12. Relief Valve Seat
13. Relief Valve Guide
14. Upper & Lower Relief Valve Disc
15. Relief Valve Housing
16. Relief Valve Spring
17. Relief Valve Cover Plate
18. Diaphragm
19. Lower Diaphragm Plate
20. Upper Diaphragm Plate
21. Clamp Bolt Gasket
22. Relief Valve Clamp Bolt
23. Relief Valve Spacer
24. Relief Valve Lock Nut
25. Relief Valve Housing Gasket





NOTES 1. VENTS FROM CLASS III BIOLOGICAL SAFETY CABINETS AND STERILIZERS SHALL BE EXHAUSTED THROUGH A CENTRAL COMBUSTION INCINERATOR IF AVAILABLE.

⚠1 2. HEPA = HIGH-EFFICIENCY PARTICULATE FILTER.
H.E. = HIGH-EFFICIENCY FILTER.

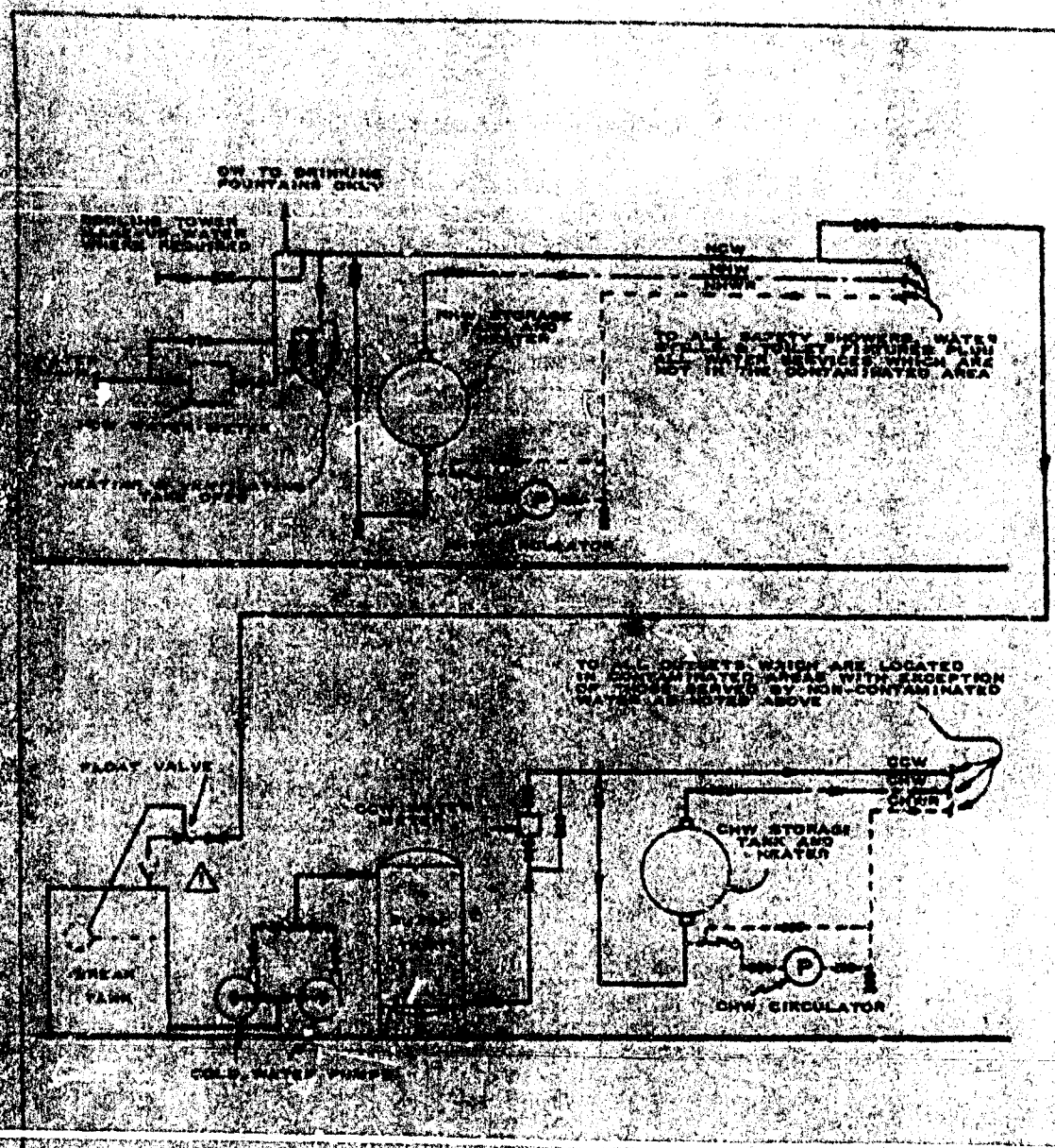
STERILIZER VACUUM, VENT, AND WASTE SYSTEMS

REV.	DATE	DESCRIPTION
⚠1	3AUG.67	WAS U.H.E. FILTER

DATE - 1 FEB. 66

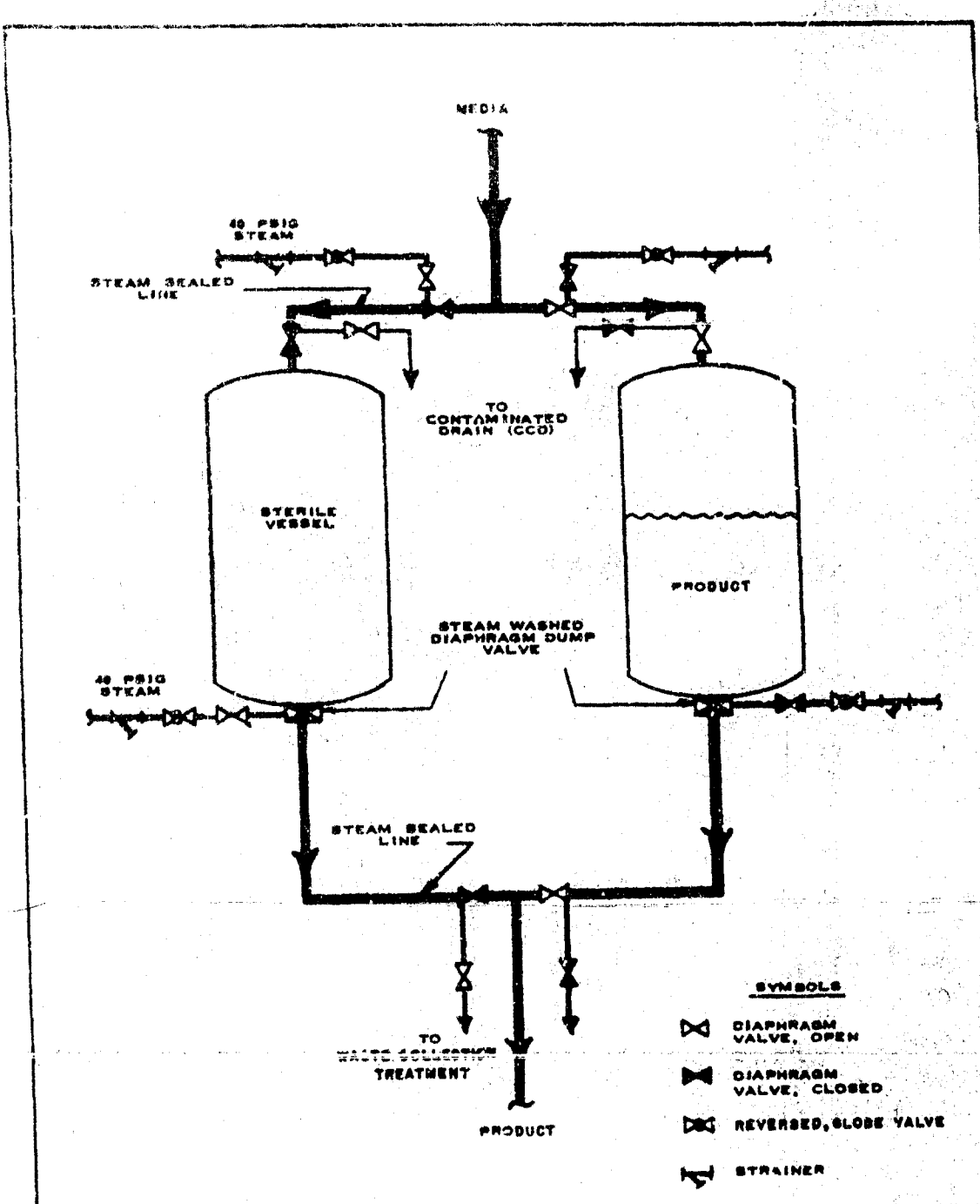
PLATE NO. 3.4

3/68



TYPICAL WATER PIPING HOOK-UP IN CONTAMINATED BUILDING		1-18-66	AIR BREAK IN NCW LINE
		DATE	DESCRIPTION
		DATE - 1 YEAR	PLATE NO. 3.6

3/66



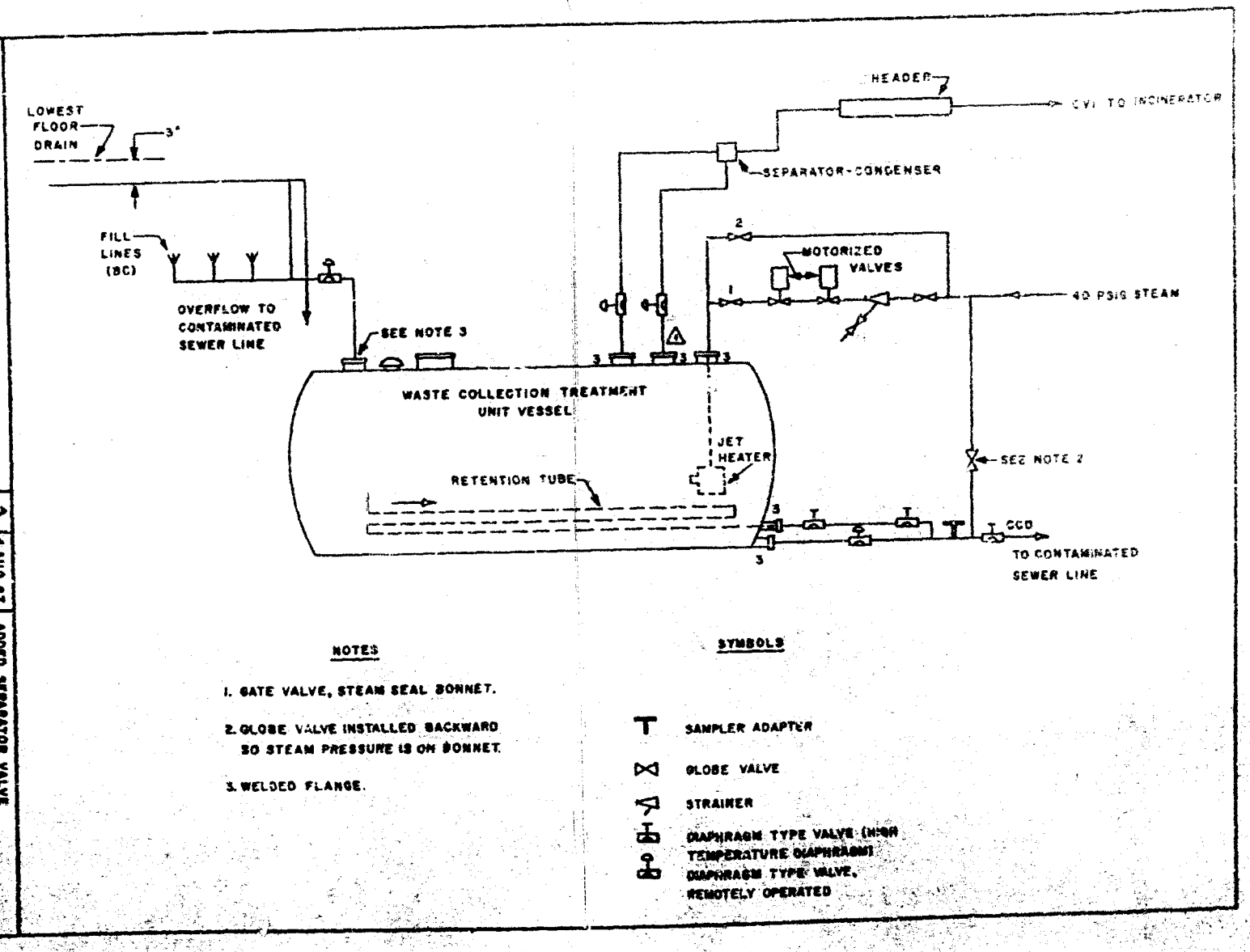
TYPICAL STEAM SEALS

REV.	DATE	DESCRIPTION
1	OCT. 67	GENERAL REVISION

DATE - 1 FEB. 66

PLATE NO. 3.6

3/68

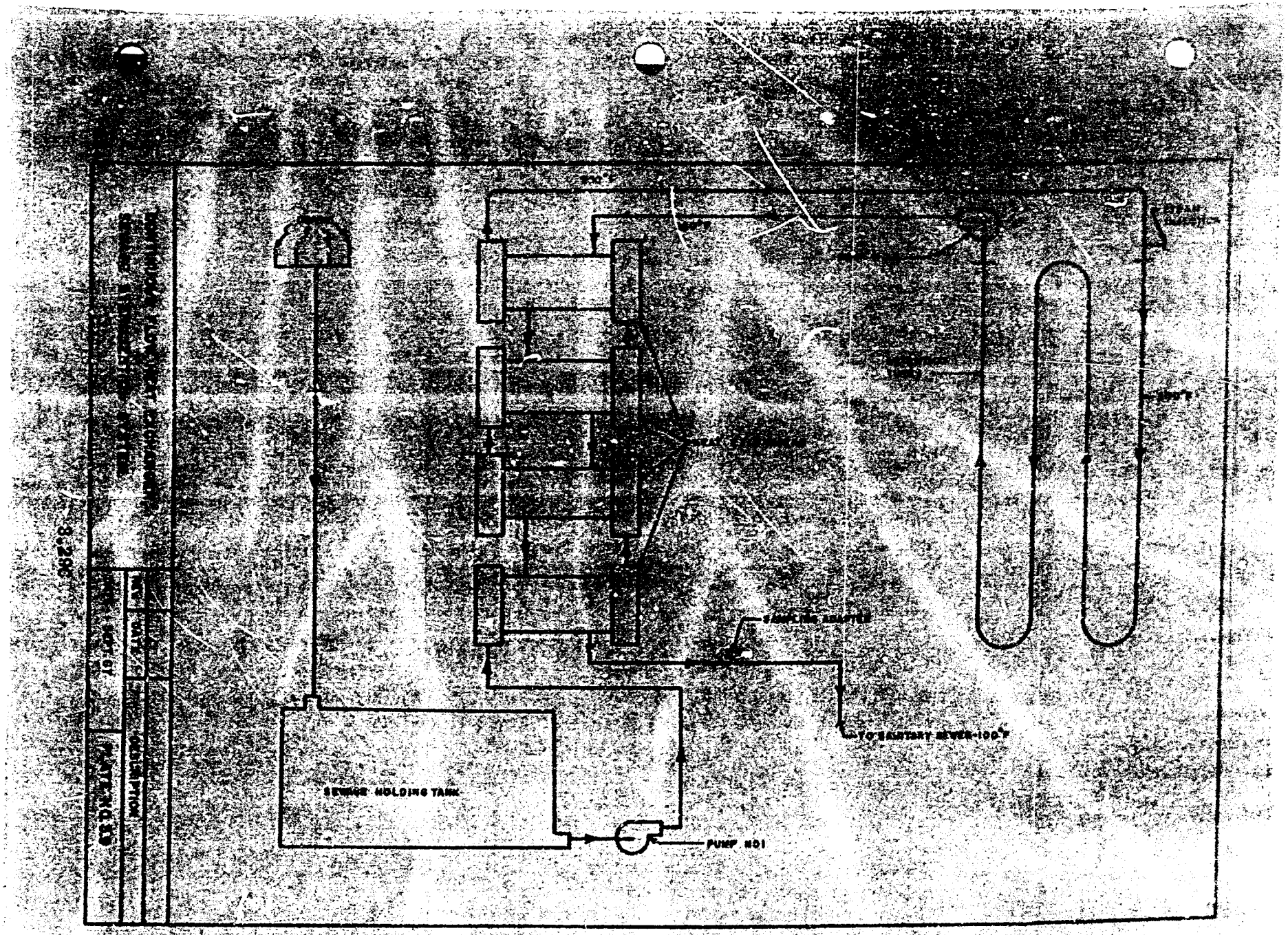


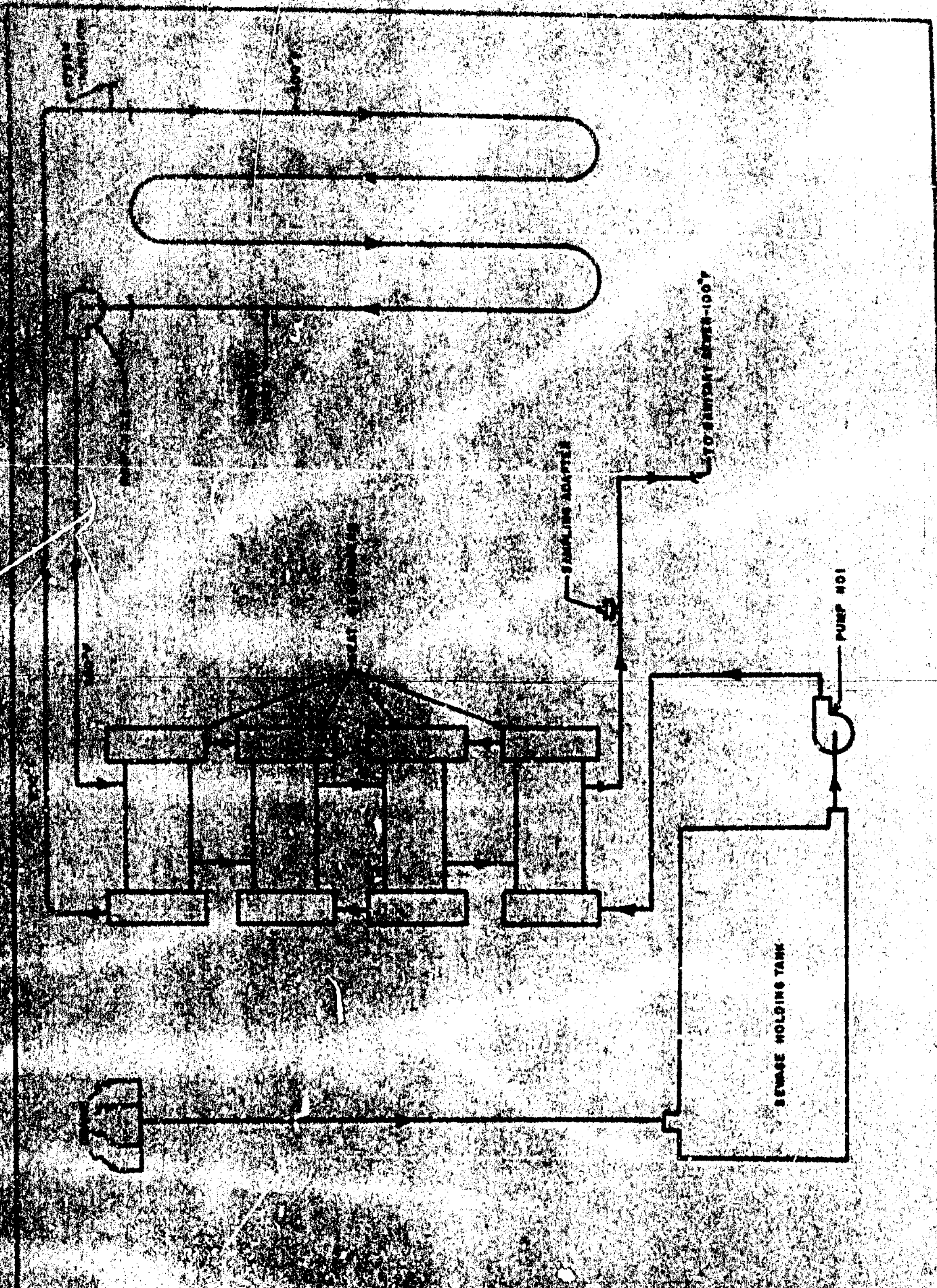
WASTE COLLECTION TREATMENT UNIT DIAGRAM FOR CONTINUOUS PASTEURIZATION

REV.	DATE	DESCRIPTION
4	4 AUG 67	ADDED SEPARATOR VALVE

DATE - 1 FEB. 66

PLATE NO. 3.9

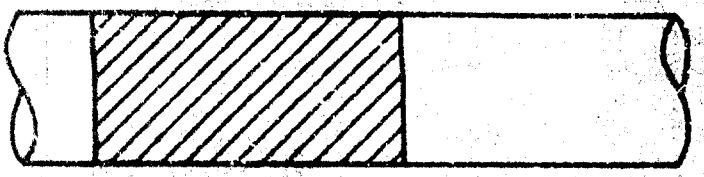

SEWAGE HOLDING TANK
PUMP NO1
TO SANITARY SEWER-100'
SAMPLING ADAPTER



CONTINUOUS FLOW HEAT EXCHANGER
SEWAGE STERILIZATION SYSTEM

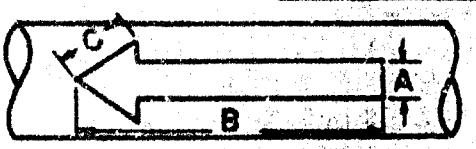
REV.	DATE	DESCRIPTION
DATE: 1 SEPT. 67		PLATE NO. 3.9

BASIC BAND COLOR



Width of band to be 2" for all pipe sizes for each color

SECONDARY ARROW COLOR



Direction of flow

Reversible flow

DIMENSIONS OF ARROW

Pipe or covering size	"A"	"B"	"C"
2" dia. or below	1/4"	2"	1/2"
2-1/2" dia or above	3/4"	3"	1-1/2"

PIPE SYMBOLS

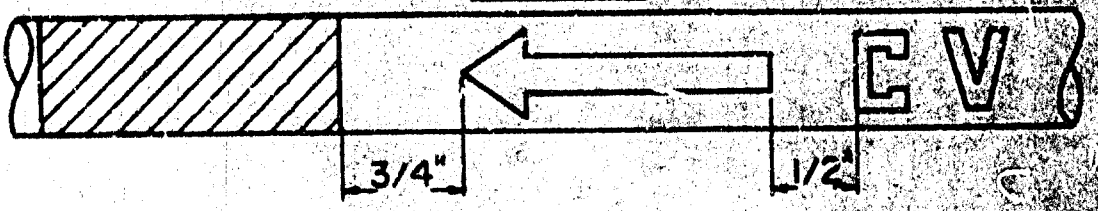
For use on 2" or less pipe or covering:

Height of letters-1/2"
Thickness of lines-3/32"
Spacing between letters-1/4"

For use on 2-1/2" or more pipe or covering:

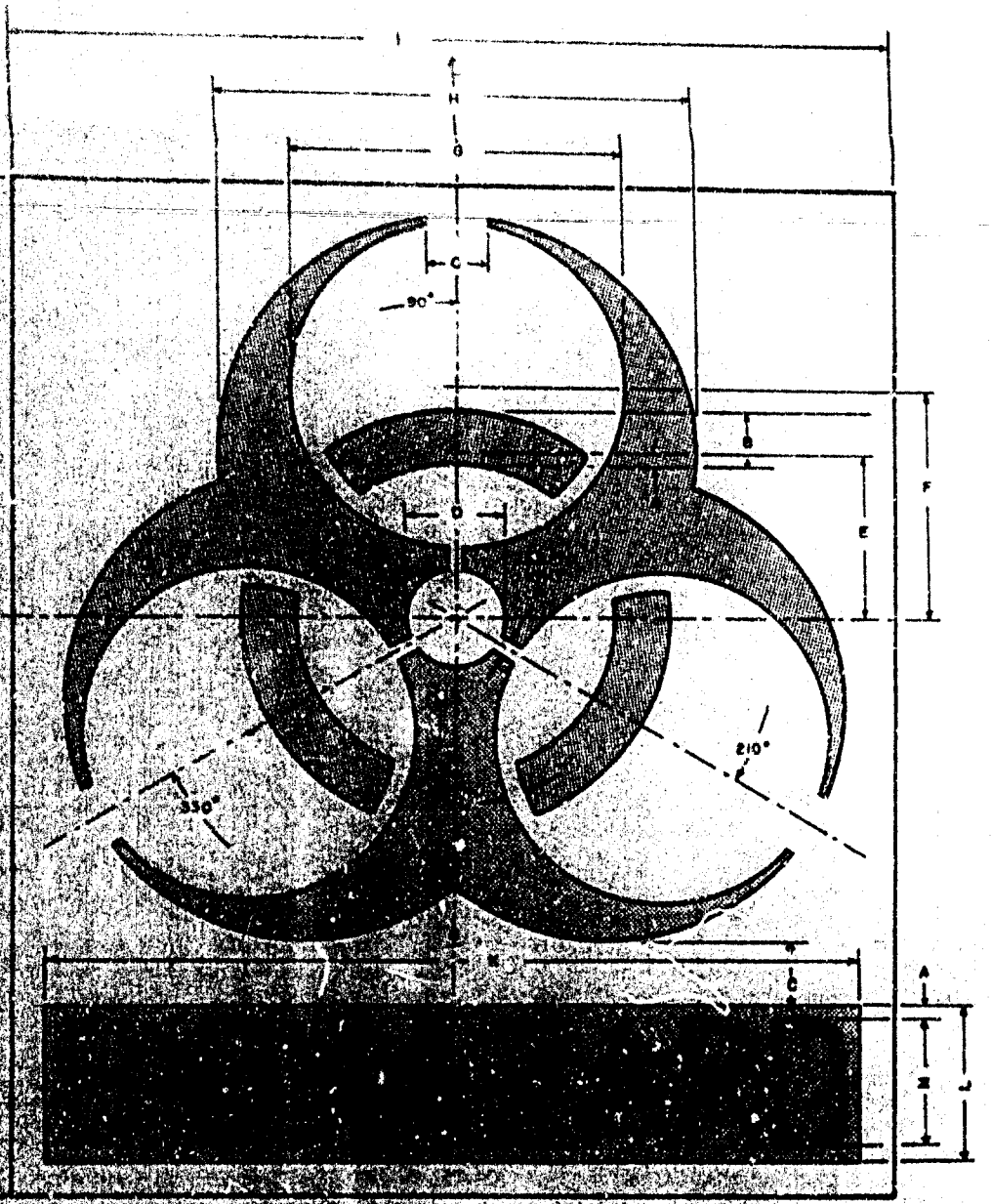
Height of letters-3/4"
Thickness of lines-1/8"
Spacing between letters-1/4"

EXAMPLE



COLOR CODING FOR PIPING	REV.	DATE	DESCRIPTION
		DATE - 1 FEB. 66	PLATE NO. 3.10

3/68



COLOR LEGEND

FLUORESCENT ORANGE-RED

BLACK

WHITE

DIMENSION	A	B	C	D	E	F	G	H	I	J	K	L	M
UNITS	1	2	3	4	5	6	7	8	9	10	11	12	13

BIOLOGICAL HAZARD WARNING SYMBOL

REV	DATE	DESCRIPTION
DATE: 1 SEPT. 87		PLATE NO. 3.11

C. General Principles

1. Confinement: Equipment must be designed for the protection of personnel in agent areas by limiting and controlling contact with biological agents. Equipment must also meet certain tests in order to be acceptable in agent areas (such as the halogen leak test, as described in Section 4.18). Special seals are required for rotating shafts in areas where they enter agent equipment.

2. Materials of Construction: Materials of construction besides meeting structural strength requirements must also be non-toxic to agents where used in contact with them (except in waste collection treatment units). Materials must also be able to withstand the corrosion caused by a variety of chemical decontaminants, and particular care should be taken in using dissimilar metals to prevent galvanic corrosion. Where field welding is required, low carbon stainless steel must be used to prevent embrittlement or carbonization at welds. To prevent the possibility of "pin hole" leaks, no castings for enclosures will be allowed.

3. Fabrication: To facilitate cleaning and to prevent the accumulation of contaminants, equipment such as cabinets shall have no pockets, burrs, or sharp corners. Floor of cabinets shall be sloped to the drain.

4. Installation, Operation, and Maintenance: Equipment shall be designed, constructed, and installed to facilitate simple operation, ease of maintenance, accessibility for cleaning, and ease of decontamination. Equipment located in safety cabinets will not be readily accessible, so that shut-down will be critical and costly, and care in design is therefore essential.

5. Economy: Equipment design and fabrication must provide the best overall economy with due consideration to procurement, installation, operation service, maintenance, and decontamination costs. Commercially available equipment should be used whenever it meets the requirements or when it can be economically modified to meet the requirements by specifying different materials of construction, special shop coatings, or other changes.

D. Organization of Section 4

The remainder of this section is divided into sub-sections that describe both standard and special equipment peculiar to a microbiological laboratory, such as safety cabinets, animal cages, refrigerators, incubators, sterilizers, etc. The final sub-section is concerned with Fort Detrick Design Practices not related to safety.

4-01 BIOLOGICAL SAFETY CABINETS

A. General: The safety cabinet is the most important single piece of equipment for prevention of laboratory infections. Safety cabinets are widely used at Fort Detrick, either as individual units, or by joining

a number together to form a cabinet system. There are two basic kinds of safety cabinets, differing in the degree of confinement of biological materials. The Class I safety cabinet is dependent on a high velocity air flow into an opening in the front, through which the worker can pass his hands. It is similar to a chemical fume hood in this respect, but differs considerably in structural details. The Class III safety cabinet is gastight, with the work done through attached rubber gloves, and is therefore suitable for more hazardous work than the Class I cabinets. The Class III cabinet is maintained at a negative pressure, and is ventilated at a relatively low rate.

Both Class I and Class III cabinets are made of stainless steel and are similar in their basic construction. The cabinet units are furnished with viewing windows, glove ports, service piping, and electrical outlets as required. They also may be furnished with openings in the rear or bottom surface for attaching equipment such as refrigerators, deepfreezers, sterilizers, and incubators, or accessories such as disinfectant dunk baths, centrifuge wells, and pass boxes. They are provided with filters for treating exhaust air.

Conveyers and elevators may be used in safety cabinet systems for horizontal and vertical transfers. They are made of stainless steel and may be electrically, pneumatically, or hydraulically operated.

B. Reference to Other Sections

1. Services and Drains: See 3-02 and 3-04, PIPING.

2. Electrical: See 5-04, ELECTRICAL.

3. Ventilation: See 2-06 and 2-07, HV&AC.

C. Class I Cabinets

1. Description: Plate No. 4.1 shows a photograph of a single Class I cabinet. Plate No. 4.2 shows a similar cabinet with the front opening closed by inserting a glove panel, and an entrance airlock attached to the right side. While providing greater confinement, the closed Class I cabinet still does not meet the gastightness requirement of the Class III cabinet.

2. Required Use: See 1-07 B, ARCHITECTURAL.

3. Design Features

a. An adapter is used to mount a 300 cfm air filter on the top of the cabinet to filter exhaust air.

C. Controls: For humidity controls and alarm, see 6-05 D, INSTRUMENTATION.

4-06 STERILIZERS

A. Required Use: See 1-07 D, ARCHITECTURAL.

B. Requirements

1. All steam sterilizers (autoclaves) shall be double jacketed, single or double-door type, with door swings as dictated by the installation, and shall conform to the requirements of Fort Detrick Purchase Descriptions and Specifications (see Appendix A for listing).

2. All sterilizers which attach to Class I and Class III biological safety cabinets are to have stainless steel sealing flanges either welded to the sterilizer outer shell or cast into the head ring.

3. Sterilizers extending through walls that separate non-contaminated areas from contaminated areas shall have a complete wall seal surrounding the outer jacket, including the sealing of all piping, conduits, and controls that extend through the wall. An acceptable method for sealing sterilizers is shown on Plate No. 4.10. Plate No. 4.11 is a photograph of a similar seal used with a pass box.

a. The doors shall have interconnected indicator lights to alert the operator when either door is open. These lights minimize the possibility of having both doors open simultaneously between a contaminated and noncontaminated area. In general the use of interlocked doors on double-door sterilizers is not required, but may be requested by the Government.

4. The steam header pressure to autoclaves shall be 40 psig, except for high vacuum sterilizers which may require 100# steam.

5. Sterilizers may be operated either manually or completely automatically depending upon usage or needs. Automatic controls are usually not required.

6. All gas sterilizers and autoclaves, except sterilizers equipped with automatic controls, shall be equipped with a flapping metal sign indicating "STERILE" and "CONTAMINATED" and mounted on front of the sterilizer.

C. Size: See 4-20 B, Fort Detrick Design Practices.

D. Conversion for Gas: Any steam sterilizer may be converted to a gas sterilizer for use with a Freon-ethylene oxide gas mixture. The manifold assembly for introducing this gas mixture into the sterilizer shall be in accordance with Plate No. 4.13.

1. Vacuum for exhausting the sterilizer shall be provided by the CVA system, see 3-02 D, PIPING.

C. Caulking: Acid and solvent resistant elastic se ling compound, as specified under sub-section 1-06 A, ARCHITECTURAL, shall be used to seal all joints and cracks in curbs and reagent shelves and where table tops, curbs, cabinets, and reagent shelves abut wall or other furniture.

D. Sloping Cabinet Tops: All contaminated laboratory storage cabinets, lockers, wall hung cabinets, and similar furniture which do not extend to the ceiling, shall have tops sloping to the front to prevent buildup of dust and facilitate drainage after washdown with decontamination solutions.

E. Flammable Material Storage Cabinet: See 1-03 J, ARCHITECTURAL.

F. Radiological Hood

1. For required use see 1-07 F, ARCHITECTURAL.

2. Outside dimensions of radiological hoods shall be either four (4) or six (6) feet in length (depending upon individual laboratory requirements) by three (3) feet six (6) inches wide by approximately eight (8) feet high, and shall have removable ends and panels. The frame for the base of the hood shall be constructed of structural steel to support a load of 4000 pounds. The counter top shall be reinforced to support the same load equally distributed. The entire interior and exterior of the hood shall be fabricated of type 304 stainless steel with 2B finish. The working surface is a stainless steel pan resting on a steel grating so that lead bricks can be used. The entire working surface is 3/8 inch deep, watertight to collect spillage. The hood is to have a five (5) inch diameter stainless steel sink welded into the pan. The sash is to have stainless steel side channels and be suspended on stainless steel and Monel cables and glazed with ¼ inch D.S. safety glass.

3. Before radiological hoods are specifically selected, the Government shall be consulted as to the type of hood to be used.

4. The radiological hood shall be equipped with an interconnected modulating by-pass damper that will maintain constant air flow to the fan regardless of the position of the front viewing window.

5. For ventilation requirements see 2-07 C, HV&AC, and for piping see 3-04 B.3, PIPING.

G. Chemical Fume Hood

1. The chemical fume hood shall be equipped with a by-pass damper as discussed in sub-section 4-09 F.4 above.

2. For ventilation requirements see 2-07 C, HV&AC, for piping and plumbing see 3-04 E, PIPING.

E. Design and Testing: All lethal code vessels shall be designed for working pressure plus full vacuum and shall also be designed for internal vacuum. Hydrostatic tests on all lethal code vessels shall be at 1.5 times the design pressure, corrected for the test temperature as outlined in ASME code, paragraph UG-99b. Lethal vessels shall also be halogen leak tested at operating pressure, after installation, as described in 4-18.

4-11 COOLING SYSTEMS

A. Cooling Towers: Cooling towers used for process equipment shall have no piping connections with cooling towers used for air-conditioning chillers. A water meter shall be installed on the makeup line to all cooling towers.

B. Coolers, Heat Exchangers, and Condensers

1. Lethal Code Service: The pressure in an exchanger being used for lethal code service must be such that the fluid side being used for cooling or heating be at a pressure higher than the agent side pressure. This allows the heat transfer fluid to leak into the agent side in case of a break and reduces the danger of contaminating the service fluid.

2. Materials of Construction: Exchangers must be of a material designed to resist corrosion of process liquids as well as decontamination solutions, avoid brittle fracture, provide long life, and be non-toxic to agent material.

3. Maintenance: Heat exchangers, coolers, and condensers shall be designed to allow quick and easy maintenance.

4. Design and Testing: Exchangers used for lethal code service shall be designed and tested in accordance with 4-10 E.

4-12 CENTRIFUGES

A. General: Centrifuges are used to concentrate agent material or used in laboratories for analytical purposes. They include air, electrical, hydraulic, and steam-driven types. The size and capacity will be determined by the specific application. Centrifuge bowls used to contain and concentrate agents shall be constructed of material non-toxic to agents. Centrifuges handling infectious agents must be located in a ventilated enclosure, unless they are equipped with safety cups (see Plate No. 4.12).

3. Free Standing: Laboratory size centrifuges may be free standing floor type or bench top models.

C. Safety Cabinet: A bottom-mounted centrifuge well may be connected to a number of the standard design Class III cabinets for housing the centrifuge. For details of a bottom-mounted centrifuge well see Fort Detrick Drawing No. F-93-1-4007-4.

4-13 PUMPS

A. General: Pumps located in areas subjected to frequent washdowns with decontamination solutions shall be painted to protect against corrosion.

B. Lethal Code Service: Pumps used in transferring concentrated agent slurries shall be of the canned rotor or other Government-approved type, or shall be enclosed in a Class III cabinet. Pumps in contact with agents shall be constructed of a material non-toxic to the agent being pumped, shall be resistant to decontaminating chemicals, and shall be of a sanitary type for ease of dismantling for cleaning purposes.

4-14 HYDRAULIC SYSTEMS

A hydraulic system may be installed as a central system or as an individual local system. Compressed air (CA) may be used as the source of pressure.

4-15 SHAKERS

Shakers handling infectious agents, unless approved safety containers are used, must be located in a ventilated enclosure.

4-16 DECONTAMINATION EQUIPMENT

A. Portable

1. See Appendix B for a discussion of decontaminating agents and methods.

2. Decontamination of equipment and laboratory rooms in contaminated areas will generally be carried out by portable equipment. Overhead sprinkler systems will not be used in laboratory buildings but may be considered for use in pilot plant locations.

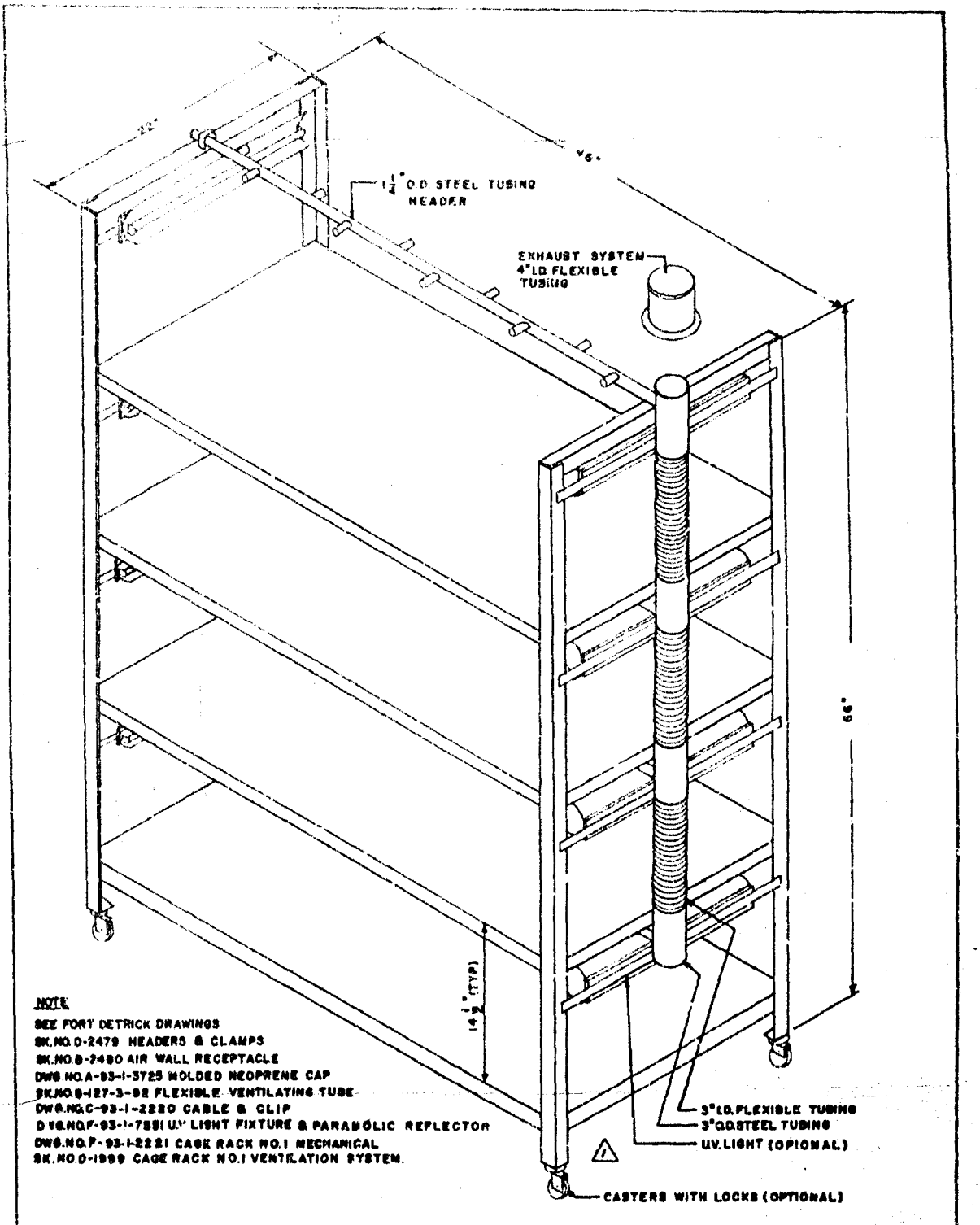
B. Installed: See 3-02 S, PIPING.

4-17 SPECIAL EQUIPMENT

A. General: This sub-section covers laboratory and process equipment of less general use or more specialized nature than that covered in the preceding sub-sections. This equipment will generally be specified by the Government in the Contract Scope of Work. Examples of such equipment are:

1. Laboratory Equipment: Balances, sterilizing ovens, conveyors, elevators, etc.

2. Process Equipment: Agitators, pelleters, freeze driers, etc.



NOTE

SEE FORT DETRICK DRAWINGS
SK. NO. D-2479 HEADERS & CLAMPS
SK. NO. B-2480 AIR WALL RECEPTACLE
DWG. NO. A-93-1-3725 MOLDED NEOPRENE CAP
SK. NO. B-127-3-98 FLEXIBLE VENTILATING TUBE
DWG. NO. C-93-1-2220 CABLE & CLIP
DWG. NO. F-93-1-7581 U.V. LIGHT FIXTURE & PARABOLIC REFLECTOR
DWG. NO. F-93-1-2221 CAGE RACK NO. 1 MECHANICAL
SK. NO. D-1999 CAGE RACK NO. 1 VENTILATION SYSTEM.

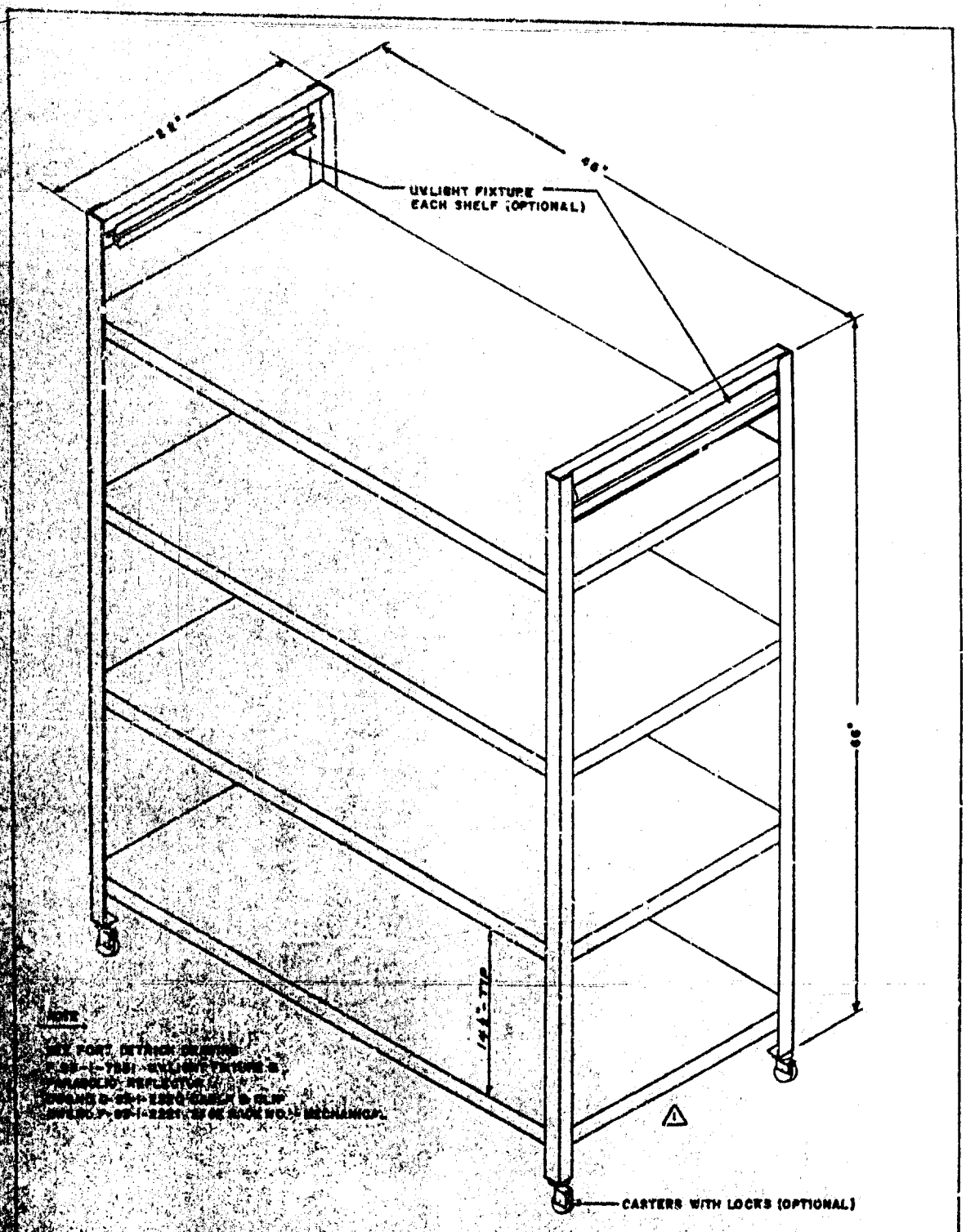
VENTILATED CAGE RACK

REV.	DATE	DESCRIPTION
1	AUG 67	GENERAL REVISION

DATE - 1 FEB 66

PLATE NO. 4.8

5/66



NON-VENTILATED CAGE RACK

REV.	DATE	DESCRIPTION
1	AUG 87	GENERAL REVISION
DATE-1 FEB 86		PLATE NO 4.9

D. Lighting Fixtures

1. Fluorescent lighting shall be provided throughout all buildings, except where vapor-tightness or other special requirements must be met, as specified below. Fluorescent lights shall be the commercial type with louvers or lens.

2. Recessed fixtures shall not be used. If surface mounted lighting has to be used, a biological sealing compound shall be used for filling joints between fixture and ceiling surface.

3. Light fixtures and all wiring components including outlets, switches, and receptacles installed in areas of "high humidity" shall be vapor-proof type. Conduits to walk-in refrigerators and incubators shall be sealed in accordance with the National Electric Code Article 300-6 (a).

4. Suitable waterproof fixtures shall be provided in all animal rooms, and elsewhere where routine operations require washing walls and ceilings.

5. See also 5-14 F, Fort Detrick Design Practices.

6. One unswitched fluorescent light shall be provided at each vault area.

E. Receptacles

1. All areas (both contaminated and noncontaminated) shall have convenience outlets which shall be duplex parallel blade 3-wire U-ground.

2. No floor type convenience outlets shall be installed, in contaminated areas.

3. At least one 2-gang, water-tight 115 V AC outlet is required in each walk-in incubator and refrigerator to supply power for shakers, stirrers, and motors. A cut-off switch and red pilot shall be provided outside the refrigerator or incubator on a nearby wall, properly labeled, for all such electrical outlets.

4. At least one 208 V, 2-wire polarized outlet shall be installed in each laboratory.

F. Grounding

1. For special process equipment specific instructions will be issued, where required.

2. For general grounding provisions, see 5-14 G, Fort Detrick Design Practices.

C. Approved U.V. Components

1. To reduce stray radiation hazard to personnel, protective louvers are required on all fixtures mounted in door barriers, and at other locations specified by the Government (see Fort Detrick Drawing No. F-93-1-6402 and Plate No. 5.1).

2. Generally, cold cathode type germicidal lamps are preferred, due to their greater life and resultant economy. Hot cathode lamps shall be used only where space limitations for U.V. fixtures are imposed by equipment design.

3. Cold cathode watertight fixtures shall conform to Fort Detrick Drawing F-93-1-7651.

4. U.V. fixtures of the hot cathode type installed in safety cabinets and on animal cage racks shall be the fixture shown on Fort Detrick Drawing F-93-1-7551.

5. See also 5-14 H, Fort Detrick Design Practices.

D. U.V. Installation Specifications

1. Each U.V. installation shall have a separate local switch, and a 1½ inch diameter blue jeweled warning light, mounted with switch plate distinct from other lighting switch plates.

2. Door barrier switches and warning lights shall be mounted according to Plate No. 1.6.

3. Caution signs will be furnished and installed by the Government at appropriate and conspicuous places at each U.V. installation.

4. The design of ultraviolet installations will be reviewed by the Government for adequacy and safety. Field tests with mock-up installations may be required prior to acceptance of new designs.

5. Ultraviolet (cold cathode type) barrier shall be installed around the door in the air lock at the contaminated side, (see Type "A" and "B" air locks, Plates No. 1.6 and 5.1). The ultraviolet door barrier shall utilize Westinghouse cold cathode fixtures, type SB-30 or the watertight cold cathode fixture shown on Fort Detrick drawing F-93-1-7651, either one complete with "Alzak" reflectors and louvers shown on the same set of drawings. Cold cathode tubes shall be Westinghouse type, 782L-30, or approved equal. Door barriers shall be protected by a continuous metal shield capable of withstanding damage from carts, fabricated preferably from sheet steel, finished on the interior with aluminum paint, sized to contain the necessary quantity of U.V. fixtures, and securely fastened to the wall. The ultraviolet source should be placed back from the door opening edge to assure cut-off of stray irradiation. Stray irradiation shall not exceed the boundary over two feet beyond either side of the door on the centerline of door opening.

B. Emergency Power

1. Starting and Duration

a. Emergency power shall start within 2 minutes of failure.

b. Duration shall be 36 hours minimum.

c. Exception: see 5-14 L.2a, Fire Detection and Alarm System.

2. Location

a. All animal rooms with ventilated cages will require emergency power within 15 minutes for cage ventilation.

b. Some refrigerators, incubators, and special equipment as specified by the Government.

c. Sump pump in basement.

3. Automatic Timers: All 440 volt, 3 phase, non-automatic starting equipment shall be re-started after power interruption in sequence, by means of cyclic timers.

5-08 FIRE DETECTION AND ALARM SYSTEM

A. Criteria for Use: See 3-05 D, PIPING and AR 420-90, Change I.

B. Signal Transmitters: See 5-14 L.2, Fort Detrick Design Practices.

C. Detection Devices: All fire detector thermostats shall be of a fixed temperature or a combination fixed temperature rate-of-rise type, and shall be of a type listed for use in hazardous locations (Class I and Class II), such as "Detect-a-Fire" Type 7020, manufactured by Fenwal, Inc. or approved equal.

1. Care shall be taken to avoid placing the thermostats over sterilizers or other hot spots unless the thermostat is set at a higher temperature.

D. Ventilation and Alarm Controls

1. Connections to the fire alarm in the central firehouse will be made by the Government.

2. A suitable number of alarms shall be installed throughout each building. Generally, eight (8) inch vibrating bells shall be installed in corridors. Four (4) inch or six (6) inch bells may be used in smaller spaces separated from main areas, such as attics and utility rooms.

2. For listing of available Purchase Descriptions and Guide Specifications covering wiring and type of instruments, see Appendix A.

3. Conduit shall be installed in accordance with 5-02 B.

4. Outlets for ventilated suit communication shall be provided as specified by the Government.

5. Consideration should be given to the installation of public address system in buildings with floor area exceeding 30,000 sq. ft.

5-13 LIGHTNING PROTECTION

A. See 5-14 O, Fort Detrick Design Practices.

5-14 FORT DETRICK DESIGN PRACTICES

A. Scope

1. This sub-section contains criteria and design information not related to biological safety considerations.

2. This sub-section is not intended to be comprehensive. In some cases additional information of a similar type may be found in the Purchase Descriptions and Specifications listed in Appendix A.

B. General

1. The post system voltages are as follows:

a. Transmission: 34.5 kilovolts, 3-phase, 3-wire 60 cycle, delta, with static wire.

b. Distribution: 4.16 kilovolts, 3-phase, 4-wire wye grounded.

c. Utilization

(1) Secondary voltages for new construction shall be 480 volts, 3-phase, 3-wire delta; 120/208 volts, 3-phase, 4-wire wye.

(2) In design of modifications to existing buildings installed voltage characteristics shall govern selection.

2. In general, the primary switch gear transformer and main secondary switch gear shall be of the outdoor weatherproof type. Each building shall have one load center for power and one for lighting. Power voltage transformation shall be 4.16 kilovolts delta to 480 volts delta 3-phase, 3-wire; lighting voltage transformation shall be 4160 volts delta to 120/208 volts wye, 3-phase, 4-wire.

Non-contaminated animal holding rooms . . 50 Foot Candles

Contaminated animal holding rooms . . . . 75 Foot Candles

Air locks . . . . . 20 Foot Candles

G. Grounding

1. Grounding shall be in strict accordance with applicable sections of the National Electric Code.

2. A grounding conductor shall be run to all load centers, switchgear, distribution panels, major junction and pull boxes, lighting panels, and all equipment served by primary voltage.

H. Ultraviolet Requirements

1. See also 5-03.

2. Approved U.V. Components

a. Cold cathode lamps and fixtures shall be Westinghouse "Steri-lamps" 782L-30 with either the Westinghouse type SB-30 fixture for nonwatertight applications or the watertight fixture shown on Fort Detrick Drawing F-93-1-7651. Low ozone output lamps are required.

b. Hot cathode lamps and fixtures shall be the G1578 "Steri-lamps" used in the watertight hot cathode fixture shown on Fort Detrick Drawing F-93-1-7551.

c. "Alzak" aluminum reflectors for fixtures (a) and (b) shown on Fort Detrick Drawings F-93-1-7651 and F-93-1-7551 respectively shall be used.

I. Laboratory Equipment

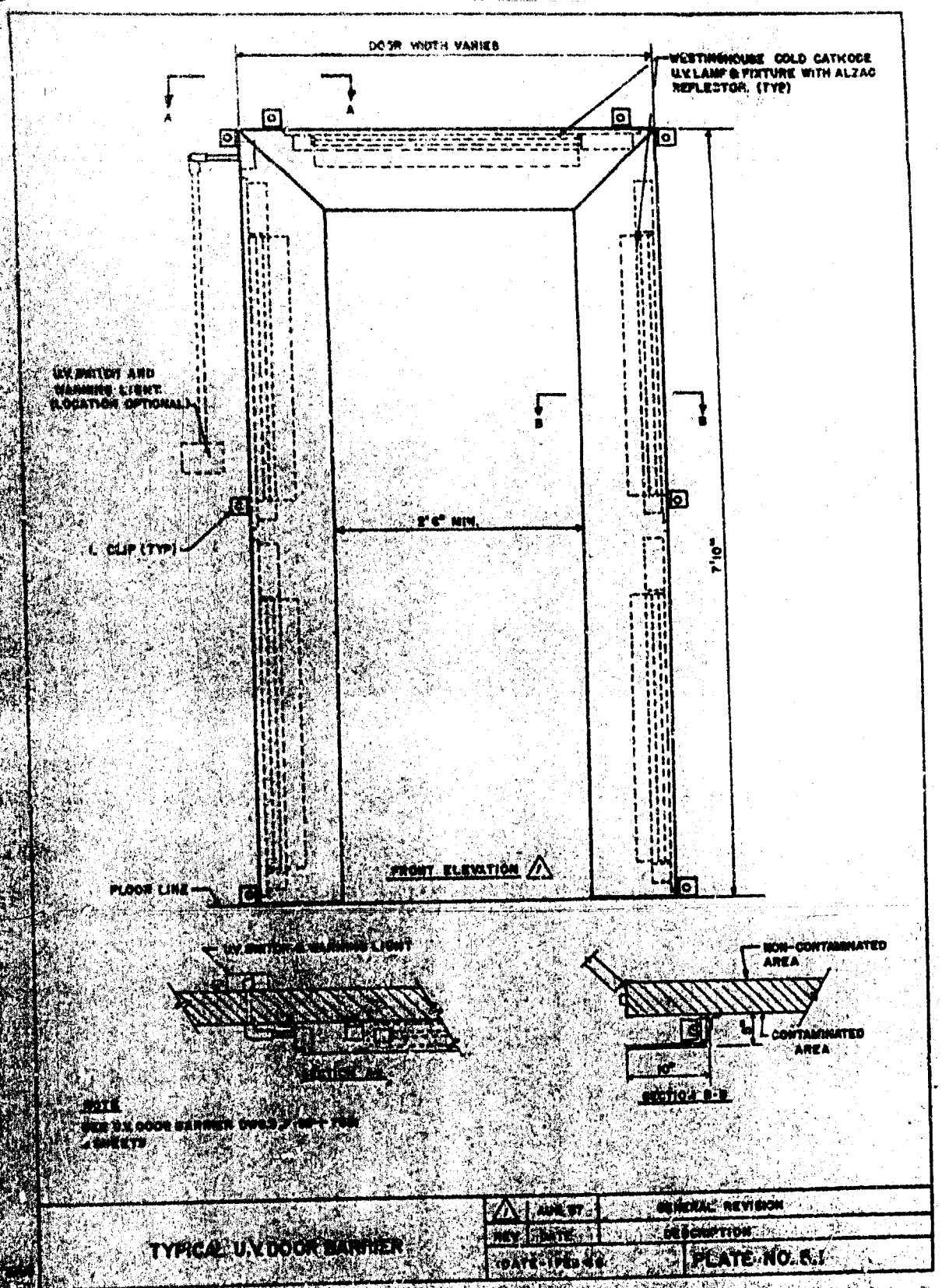
1. See also 5-04.

2. Equipment and areas in which flammable materials are to be used or stored, shall be provided with explosion-proof fixtures and devices, and installed in accordance with National Electric Code.

3. Laboratory tables shall be provided with 115 V service to built-in convenience outlets, and these shall be supplied with approved grounded receptacles. Specific requirements of this type of equipment shall be obtained from manufacturers' catalogs.

J. Miscellaneous Electrical Specialties

1. See also 5-05.


DOOR WIDTH VARIES
WESTINGHOUSE COLD CATHODE U.V. LAMP & FIXTURE WITH ALZAC REFLECTOR. (TYP)
A
A
B
B
U.V. SWITCH AND WARNING LIGHT LOCATION OPTIONAL
L CLIP (TYP)
3'-6" MIN.
7'-10"
FRONT ELEVATION
FLOOR LINE
U.V. SWITCH & WARNING LIGHT
NON-CONTAMINATED AREA
CONTAMINATED AREA
10"
SECTION B-B
NOTE
TYPICAL U.V. DOOR BARRIER
DATE
DESCRIPTION
GENERAL REVISION
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control instrument or recorder is in a less-contaminated area. The second situation is where both the sensing or operation device and the control instrument or recorder are in the same contaminated area.

Instruments or controls in the contaminated area shall be fabricated as far as practical of corrosion-resistant material capable of withstanding a variety of decontaminating solutions (see Appendix B). Instruments in contact with agents shall be constructed of material non-t ic to agent material.

2. Tubing: Pneumatic interconnections shall be made with copper tubing as called for in the piping specifications (see Appendix C). The use of non-flammable plastic tubing for instrument connections shall not be permitted but plastic coated copper tubing may be used in areas where decontaminants may attack copper. All tubing passing through walls or floors between a contaminated and non-contaminated area or between areas of different levels of contamination shall make this penetration via bulkhead fittings mounted and gasketed to steel plates set in the floor or wall. See Plate No. 1.17.

3. Panelboards: Panelboards in contaminated areas shall be of the free standing fully enclosed type furnished with fully gasketed doors hung with full-length piano hinges. All instruments shall be provided with gasketed transparent covers. In addition, a gasket shall be provided between the instrument bezel and the face of the panel. The panel shall be constructed of sheet steel with all joints welded and ground smooth. Dry air at 0°F dewpoint shall be used to purge the interior of cabinets and instruments installed in corrosive atmospheres.

All metallic surfaces shall be painted to protect against corrosion from decontaminating solutions. In pilot plant and other areas where higher levels of contamination may exist, the use of stainless steel should be considered.

4. Wiring: All instrument and control wiring shall be in rigid conduit or mineral-filled cable. All conduit passing through a wall or floor between a non-contaminated and a contaminated area or between areas of different levels of contamination shall be sealed internally as specified in 5-02 B.3, ELECTRICAL. Sealing around conduits shall also be as specified in 5-02 B.4. Entrance of instrument wiring into Class III cabinets shall be with mineral-filled cable and compression fittings to provide gastightness.

E. Installation: All instruments and controls shall be installed in such a fashion as to avoid crevices, cracks, and pockets. Conduit runs and instrument tubing shall be mounted off the wall as shown in Plate No. 3.2 to promote ease of painting and cleaning.

F. Instrument Air Supply (IA): See Section 3-02 M, PIPING, for details on the instrument air system.

6-02 SERVICES

A. Water Break Tank

1. Piping Arrangement: See Plate No. 3.5 for details on the water break tank used for the contaminated water service. The break tank make-up valve shall be a self-operated mechanical linkage type with stainless steel ball float. The valve shall have an inner pilot valve operated by the float to facilitate tight trouble-free shut-off when desired upper level is attained. The break tank shall be an atmospheric tank with water supplied at the top to prevent backsiphoning.

2. Controls: Water supply pump operation shall be controlled by a cage type float switch externally mounted on the surge tank. Electrode type level controls are not acceptable. The float switch shall start the pump on surge tank low level and shut down the pump on high level. The contaminated water (CCW) system pressure shall be maintained at 50 psig during use by means of bleeding compressed air (CA) to the tank through a pressure regulating valve. This will insure a constant water supply pressure for the building. A back pressure regulator shall relieve the excess air pressure in the surge tank during filling operations. An air pressure relief valve (vented to atmosphere) shall be installed to prevent excessive pressure in the tank. The tank shall be equipped with a sight glass and a water pressure gage accurate to ½ psi.

B. Back-Flow Preventer: A spring loaded ball type check valve may be used as a back-flow preventer in the CCW water line branches to the Class III cabinets. The use of these valves will serve to isolate the Class III cabinets from the laboratory bench top service water taps. A back-flow preventer used on the building supply shall be specified in accordance with "Cross-Connection Manual of Recommended Practices" by the Los Angeles Dept. of Health. (See Plate No. 3.3)

C. Waste Collection System

1. Batch Treatment: See Section 3-04 I, PIPING for a description of the system and the operational requirements for batch waste treatment and Plate No. 3.7 for a diagram of the system. Operation is manual with the necessary alarms and interlocks provided.

2. Continuous Treatment: See Section 3-04 I, PIPING for a description of the system and the operational requirements for continuous waste treatment and Plate No. 3.8 for a diagram of the system. Operation is automatic.

3. Controls: The waste collection tanks shall be provided with level, temperature, and time cycle controls for operation of the system. If requested by the Government, the control panel, with suitable manual by-pass controls, shall be located outside the waste collection treatment room.

If this is done, suitable remote-operated valves shall be provided for the b tch system in place of the manual valves shown in Plate No. 3.7.

a. Level: The batch waste collection tanks shall be equipped with a level recorder to indicate the level of the tank contents at all times. The continuous system shall have a level recording controller which will shut off the steam supply and the tank discharge valve on low level; it will close the tank fill line on high level and simultaneously open the fill line for the spare tank. Both systems shall have a visible and audible alarm activated on high level.

b. Temperature: The batch waste collection tanks shall be equipped with a temperature recorder to show the temperature of the liquid in the tanks. The continuous system shall have a temperature recording controller which will modulate the 40 psig steam supply to maintain the required liquid operating temperature. The tank effluent shut-off valve will close automatically and sound an alarm if the required temperature is not maintained. Both systems shall be equipped with an indicating thermometer.

c. Pressure: Waste collection treatment vessels shall be provided with local as well as panel mounted pressure indicators. In no case shall pipes or tubing connected to the waste collection tanks be brought out of the tank area (see 6-01 A.3). Therefore, the control panel gage shall receive its signal from a transmitter located on the tank.

d. Timer: A timer shall be used for the batch operation to control the duration of the sterilization period. The timer should be connected to the temperature recorder so in the event the waste liquid temperature falls below the min' um operating temperature, the timer will reset and not commence timi g until the liquid temperature rises again and exceeds the minimum operating temperature. On completion of the sterilization cycle a visual alarm shall light on the control panel.

e. Pressure Release: See 3-04 I.5, PIPING for details.

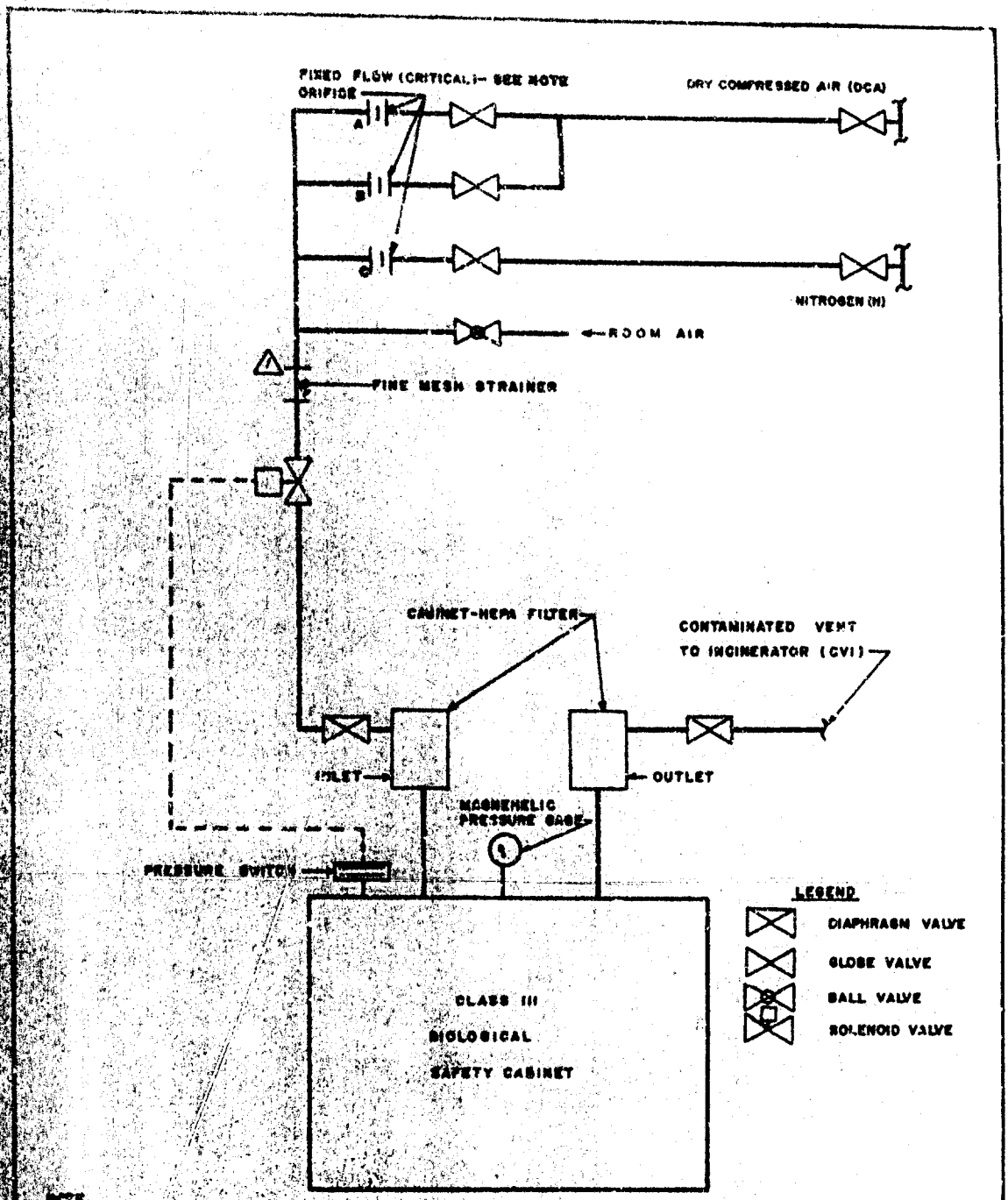
6-03 BUILDING VENTILATION

Ventilation controls and instrumentation are covered in Section 2-11, HV&AC.

6-04 SAFETY CABINETS

A. Pressure Gage: Magnehelic type gages for indicating negative pressure shall be provided for each isolated section of a cabinet system.

B. Pressure Switch: Each isolated cabinet section shall be provided with an alarm device which indicates with a buzzer and light when the cabinet internal pressure reaches -½" w.g. with respect to that of the room. The buzzer shall sound only when the condition exists; however, the light shall remain lighted until manually extinguished.



NOTE:
DCA-THROUGH ORIFICE "A" ONLY
N-THROUGH ORIFICE "B" ONLY
DCA & N - MIXTURE THROUGH ORIFICES "A" & "B"
ORIFICE SIZES DETERMINED BY CABINET VOLUME SERVED
HEPA - HIGH EFFICIENCY PARTICULATE FILTER

CONTROLLED ATMOSPHERE PIPING FOR CLASS III CABINETS	1	AUG 67	GENERAL REVISION
	REV.	DATE	DESCRIPTION
	DATE - 1 FEB, 66		PLATE NO. 6.1

GLOSSARY

Absolute Filter - see "high-efficiency particulate filter".

Aerosol - a suspension of very fine particles of solid or liquid in air or gas.

Agent - an infectious microorganism or toxin that is being handled in the course of research, process development, or testing.

Air Incinerator - see "combustion air incinerator" and "electric air incinerator".

Air Lock - an unventilated section of corridor isolated by doors, used to separate areas with different levels of contamination and at different air pressures, which permits passage of personnel and/or equipment without air flow. See also "U.V. air lock".

Air Tight or Airtight - see "gastight".

Aircraft Grade Compound - a sealing compound used for sealing biological safety cabinets and for other caulking uses where a gastight seal is required.

Animal Cage - container, generally metal but may be of plastic either autoclavable or disposable, designed for permanent housing of (usually individual) animals; may be individually ventilated or open to surrounding atmosphere. Used in both non-contaminated and contaminated area.

Animal Cage Rack - stack of steel shelves, generally movable, used to hold animal cages; sometimes equipped for U.V. irradiation and sometimes provided with exhaust manifold to accommodate ventilated cages.

Animal Holding Room - room meeting suitable isolation criteria used to house animals in cages before and after experimental use; may be in non-contaminated or in contaminated areas. Used interchangeably with "animal room".

Area - generally used in this manual to designate a portion of a building at a given level of contamination, as set off from adjoining portions of different contamination levels. Used somewhat interchangeably with "space".

Array - see "cabinet array".

Attic - an important utility service area for the laboratories containing much service equipment including the ventilation equipment.

Autoclave - a chamber used for heat sterilization of materials and equipment by direct exposure to steam under pressure. An autoclave that has been modified to permit optional use of a gaseous decontaminant instead of steam is generally referred to as a "gas sterilizer" in this manual. See also "gas sterilizer".

Back Flow Preventer - a manufactured piping device of the type that has two spring-loaded vertical check valves and one spring-loaded, diaphragm-activated differential pressure relief valve. It is installed in a water supply line to prevent reversal of water flow in case the supply pressure falls below the downstream pressure. See also "break tank" and "vacuum breaker".

Bacterial Filter - used for removal of microorganisms and other undesirable particulates from air or other gases. Includes "high-efficiency filters" and "high-efficiency particulate filters", as well as less efficient types.

Biological Filter - see "bacterial filter".

Biological Safety Cabinet, Class I - see "Class I biological safety cabinet".

Biological Safety Cabinet, Class III - see "Class III biological safety cabinet".

Biological Spill Alarm-a system provided in large infectious disease buildings to warn building occupants that release of hazardous material has occurred. Alarm switches are conveniently located throughout the building and give a coded audible signal and actuate a warning light.

Biologically Separated - term applied to areas which are isolated from each other by change rooms and shower.

Blowcase - see "waste collection treatment unit".

Break Tank - a tank that provides an air space in a water supply line in such a manner as to prevent reversal of water flow in case the supply pressure falls below the downstream pressure. It is considered more positive than the "back flow preventer" or "vacuum breaker".

Cabinet, Class I - see "Class I biological safety cabinet".

Cabinet, Class III - see "Class III biological safety cabinet".

Cabinet Array - a number of Class III biological safety cabinets joined together. An array may be divided into two or more "cabinet systems" by gastight doors or fixed partitions.

Clean Room - see "clean".

Clean-to-Contaminated Axis - a hypothetical line along which there is unidirectional flow of non-contaminated materials (including ventilation air) toward, and of contaminated materials away from, the contaminated work area.

Combustion Air Incinerator - a fuel-fired furnace for the sterilization of contaminated air (or other gases), in which all gases will have reached a minimum temperature of 550°F (measured at the stack base) before being discharged. Used for larger capacities than electric air incinerators.

Construction Grade Compound - a caulking compound used for all exterior and interior caulking, except where aircraft grade compound is required (see "aircraft grade compound").

Contaminated - synonymous with "potentially contaminated", i.e. any material, equipment, person, or animal in a contaminated area is considered to be contaminated with infectious microorganisms.

Contaminated Area - a building area with definite boundaries where hazardous biological work is being carried out, separated from non-contaminated and other contaminated areas by suitable barriers.

Contaminated Change Room - dressing room for removal of laboratory-type clothing before entering clean change room, through a mandatory shower, to don street clothing.

Contaminated Service - a service or utility, such as water or vacuum, which serves a contaminated area and is therefore segregated from similar services to non-contaminated areas, even though the service itself is non-contaminated.

Contaminated Suite - a group of contaminated laboratory rooms that is isolated from non-contaminated areas and other contaminated areas by change rooms and U.V. air locks.

Decontamination - the word "decontamination" is a provincial term used at Fort Detrick to describe all sterilizing, disinfecting, sanitizing, and washing procedures.

Decontamination Shower - see "disinfectant shower".

Deep-Bed Filter - common form of high-efficiency filter for low pressure use in ventilation system.

Demand Factor - Per cent of total connected load (for utilities).

Diaphragm Valve - widely used in contaminated service because of zero leakage at the stem (also referred to as "Saunders valve").

Disinfectant Shower - unit at exit from ventilated suit area in which suit is externally decontaminated by mist or spray of disinfectant, such as peracetic acid, before being removed.

Dirty - as used in this manual, generally means "contaminated", but latter term is preferable.

Dollinger Filter - see "pipe line filter".

Electric Air Incinerator - an electrically heated chamber for sterilizing contaminated air (or other gases) by heating it to a minimum temperature of 575°F for three seconds. Generally used for smaller capacities than combustion air incinerators.

Exfiltration - (ventilation term) ductless flow of air from a space to an adjoining space at lower pressure.

Filter - see "bacterial filter".

Freon Tight - see "gastight".

Fretoclave - name previously given to autoclave modified for use with Freon-ethylene oxide gas mixture; now called "gas sterilizer".

Gas Sterilizer - an autoclave that has been modified to permit optional use of a gaseous decontaminant instead of steam for sterilizing materials.

Gastight - free from leakage when subjected to the Standard Halogen Leak Test, as defined in sub-section 4-18, EQUIPMENT.

Germfree - free of all microbial life detectable by examination.

Glove Box - see "Class III biological safety cabinet".

Gravity Exhaust - (ventilation term) discharge of air, resulting only from pressure differential, from a ventilated room to the outdoors through an exhaust duct.

High-Efficiency Bacterial Filter - see "high-efficiency filter".

High-Efficiency Filter - having a nominal efficiency of 95% for removal of 1 to 5 micron particles from air.

High-Efficiency Particulate Filter - (HEPA), having a minimum efficiency of 99.97% when tested with 0.3 micron DOP particles.

Hood Area - see "ventilated suit area".

Incinerator - see "combustion air incinerator", "electric air incinerator", and "refuse incinerator".

Infectious Agent - see "agent".

Post-Wide Alarm System - a system to detect abnormal operation of any critical or important mechanical device or system. Warning is given at a building annunciator panel and at a central annunciator panel that is manned 24 hours a day.

Pressure Tight - free from leakage in soap test at +4 inches w.g. pressure.

Process Piping - piping (other than waste piping) intended to carry product or agent.

Product - material that contains agent.

Receiving Room, Contaminated - an area for holding contaminated equipment and materials until they can be sterilized and passed through double-door autoclaves or gas sterilizers that open into the non-contaminated receiving room.

Receiving Room, Non-Contaminated - a service room generally at the rear of the building that is maintained as non-contaminated area. Supplies delivered to the building are placed in the receiving room before transfer through a U.V. air lock to the contaminated receiving room.

Refuse Incinerator - a fuel-fired furnace for the combustion of organic wastes, in which all gases will have reached a minimum temperature of 1350°F before discharge.

Respirator - a conventional device covering the nose and mouth, which provides a filter for inspirated air.

Rodent Proof - incorporating prescribed structural and architectural features in building design that prevent access or harboring of rodents and other vermin.

Safety Cabinet, Class I - see "Class I biological safety cabinet".

Safety Cabinet, Class III - see "Class III biological safety cabinet".

Safety Shower - provided in chemical and radiological laboratories for same function as in conventional, non-biological laboratories.

Sealant - see "aircraft grade compound" and "construction grade compound".

Service Piping - piping other than waste piping or process piping.

Shower - see "change room", "disinfectant shower", and "safety shower".

Simulant - non-infectious microorganisms used as substitute for infectious microorganisms in testing processes or effectiveness of safety measures.

Speaking Diaphragm - plastic sheet installed in wall, door or window to permit voice communication through barrier between areas of different levels of contamination.

Steam Seal - section of process piping between two valves, kept filled with steam when not in use, to isolate an agent-containing vessel or line from another process vessel or process line, from waste drain lines, etc.

Sterilization - complete destruction or inactivation of microorganisms.

Sterilizer - see "autoclave".

Suit Area - see "ventilated suit area".

Suite - see "contaminated suite".

System - see "cabinet system".

Toxin - a metabolic product of microorganisms poisonous to man or animals.

Type I Filter Media - spun glass wool mat of 1.28 micron fibers used in high-efficiency filter.

Type II Filter Media - spun glass wool mat of 2.54 micron fibers generally used ahead of Type I media in high-efficiency filter.

Ultra-High-Efficiency Filter - see "high-efficiency particulate filter."

Ultraviolet - see "U.V."

U.V. Air Lock - an air lock located between areas of different levels of contamination and air pressure. It provides a dead air space for the transfer of personnel and/or equipment without air flow. The interior is irradiated with U.V. and painted with aluminum paint to give good U.V. reflectance (see also "air lock").

U.V. Clothing Discard Rack - a rack that holds a standard laundry bag and is protected at the top with a curtain of U.V. Clothing worn in the contaminated laboratory is discarded into this laundry bag in the contaminated change room.

U.V. Pass Box - a pass box in which U.V. radiation is used for surface decontamination of material or equipment (see "pass box").

Uncontaminated - same as "non-contaminated".